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CONTENTS

NEWS



This Week: Whitewash on disaster island? p 291

Comment 290
University redundancies/The Brundt summit

This week 291

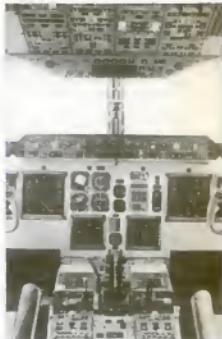
Desert island risks/Hunting of the quark/Rough deal for handicapped/Bone of contention/Bioterror drain/Arthritis hope New blood for Britain/The day the lights went out/Row over Mars effect/Shuttle goes to work/Second-best safety

Monitor 306

Migraine trigger shows up in the blood/Ugly faces are remembered/Gamma-ray laser is a long way off/Human genes into mice/Is man a many spoused thing?/The axion vanishes

Technology 310

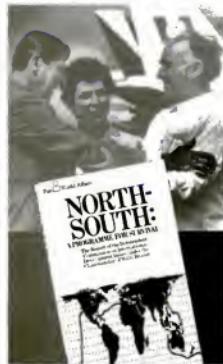
Doubts about laboratories scheme/Second coming of an Apple computer/Merseyside clean-up/Comeback for trolleybuses Technology for the disabled



Aircraft computer—the pilot's friend? p 302

Cover by British Aerospace

FEATURES



The Cancun meeting—a poke in the eye for Brandt p 299

AP

Brandt summit—high hopes and deep despair 299

The leaders of 22 countries left the North-South meeting in Mexico last week with mixed feelings. They could not deny there was some progress, but they were hard put to say whether the South would benefit

Ziauddin Sardar

Automatic airliners—ready for take off? 302

Television in the cockpit, computer-generated instruments instead of pointers, and fewer pilots are in new airliners Bill Sweetman

Cool powders run fast 313

Your salt will flow better if it is cool and dry than if it is warm and dry. This explains why avalanches happen at very low temperatures

Dr Neiton Pilpel

IN COLOUR

Economic assault on Chagas disease 321

The chronic fatal parasite infection known as Chagas disease decimates the people of South America. Could land management —rather than new vaccines—control it?

E. H. Bucher and C. J. Schofield

Ann Ronan Picture Library

Can the Japanese really innovate? 325

Japan has become the world's leading industrial nation. But its leaders are worried that the country has trouble thinking up anything new

Terry Boardman

VIEWPOINTS

Review 316

Professor Joseph Rotblat assesses the scientific evidence on Hiroshima and Nagasaki/Astronomer in the ascendant/Tories, intolerance and the new biology/Transfer of technology and the start of the US textile industry/Science or skulduggery?

Forum 327

Tony Jones on barren space/Senior scientists look for jobs Rupert Grey on flourishing crocodiles/Bring in standards for the unemployed! Dan Greenberg interviews the ebullient Grant Swinger/John Hillaby's Californian notebook/Tam Dalyell MP on the Channel Tunnel/Enigma

London School of Tropical Hygiene



Route of entry for the Chagas parasite: the eye, p 321



Why egg timers work better in cold climates, p 313

Next week

London—the flood threat lifted

Canvey—time-bomb in the Thames

Good behaviour stops heart attacks

and in colour

Can we save the coral reefs?



This One



7XQW-J3D-6ZQ7

Ariadne

newscientist

Vol 92 No 1277 29 October 1981

Commonwealth House 1-19 New Oxford Street London WC1A 1NG Tel: 01-404 0700	Subscription inquiries: 0444 59188 Readers' services 01-404 7000 Ext 256 Telex: 915748 MAGDIV G
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PUBLISHED WEEKLY. Publisher's subscription rate, Ireland: £32-00. Overseas surface mail: £39-50 (Not applicable to the USA and Canada). US and Canada (airfreight) \$86-90. Registered at The Post Office as a newspaper and printed in England. 2nd class postage paid at Jamaica NY 11431. Airfreight and mailing in the USA by Publications Expediting Inc, 200 Meacham Avenue, Elmont, NY 11003. © IPC Magazines, 1981.

COMMENT

Terms of employment

AS BRITAIN'S DOLE queues gradually approach 3 million people out of work, many of the country's 34 000 or so university academics believe that a magical thing called "tenure" immunises them against redundancy and guarantees them a job for life. At least, that is the picture that emerges collectively from the academic community. But talk to university teachers individually and it is surprising how many of them accept that there will have to be some cuts—so long as it is someone else, of course. The questions the academics want answered, however, are: Who and where? And under what terms?

In the further education boom during the 1960s, Britain's new universities hired new teachers, some of whom would have found it difficult to obtain teaching posts in more normal times. When this orgy of educational expansion ground to a halt, the academic establishment froze: since then few academics have changed jobs and it has become increasingly difficult for young researchers on short-term grants to make the transition to a full-time tenured post. Thus some of the country's brighter scientists are living from hand to mouth while less-capable researchers, who just happened to be around at the right time, look forward to many years' safe employment. And the penetration of the less-able academics goes up into the establishment, thanks partly to promotions awarded during the boom years. Few senior researchers would find it difficult to name someone at their level who collects a comfortable salary for dropping into the department from time to time to pick up his post and his salary slip while steadfastly refusing to teach anyone lest it interfere with his mythical research.

What is the solution? Unfortunately, there are difficulties with any course of action. For example, opt for early retirement and good and bad professors will fall by the wayside, leaving room for some of their mediocre colleagues to ascend the ladder. And if the aim is to cut numbers, such action would not vacate rungs at the foot of the ladder. Another option—to seek voluntary redundancies—could be equally destructive, because the better researcher would be the one who could take the money and step immediately into another job, probably abroad.

Tenure once meant something: it was a guarantee that a researcher would not be fired because his senior colleagues did not like his ideas. With legislation in place to protect anyone—from professors downwards—from unfair dismissal this original need to protect the jobs of scientists no longer applies. But before the redundancies can begin it will probably take a court case to sort out just what "tenure" means and to put a ceiling on redundancy payments. A court isn't likely to uphold a researcher's right to receive severance pay equal to his salary up to retirement age, when no one else, not even a civil servant, is similarly blessed. With that issue decided, the picture will be clearer and universities can begin to think seriously about how to cut their complements without cutting their competence. □

The road from Cancun

NO ONE EXPECTED the 22 world leaders who gathered at Cancun, Mexico, last week to solve the Third World's food, energy and technology problems. But should we be satisfied with what was achieved? This encompassed a loose agreement to do something about food security, eliminate world hunger by the year 2000 and, maybe, to work toward the creation of an energy arm of the World Bank (this issue, p 229). However, the key issues of development were not even on the agenda at Cancun. The question of the economic and technological institutions and structures that maintain the Third World in a perpetual state of dependence; the control that multinational companies exert over science and technology; and the issues of technical cooperation between the developing countries were blatantly ignored. It is all very well for Margaret Thatcher to return to Britain and tell the House of Commons that the poor countries of the world must do their bit to ensure their own development; but what can the Third World do without adequate tools? It is time to stop talking generalities and to start talking seriously about specifics. The North has priceless technological weapons that could help the South to overcome crippling disease and shortages of food and energy. The industrialised countries must offer the most suitable tools and find acceptable ways of passing them on to the Third World. □

THIS WEEK

Canvey Island—it's safer on paper

A GOVERNMENT safety report to be published next month claims that risks to people near the industrial complex at Canvey Island in Essex are now 20 times less than they were during a previous survey three years ago. The report, from the Health and Safety Executive (HSE), a government watchdog, will be a key document at the public inquiry into calls for the closure of British Gas's methane terminal on the island. The inquiry is now set to start on 5 January following a postponement ordered this month by ministers.

Local residents who have seen the report claim that it is an attempt to "whitewash" the dangers from explosions and toxic clouds that would threaten them after an accident at any one of the petrochemical plants in the area. The report claims that "some major changes in the operations of the firms" on the island have cut risks of leaks, ruptures and overflows from containers storing massive quantities of liquefied gases, ammonia, hydrogen fluoride and ammonium nitrate.

But the HSE says that the major reason why it thinks the risks are now lower is a theoretical reassessment of the risks from toxic and explosive clouds carried out by the Safety and Reliability Directorate (SRD) of the UK Atomic Energy Authority, the HSE's consultants. The report says that residents now stand a chance of 35 in a million each year of being killed in a disaster. The figure in the HSE's 1978 report on Canvey Island was 740 chances.

Three "reassessments" have drastically reduced the theoretical risks of a



Liquefied gas comes ashore at British Gas's terminal: the HSE thinks that an accident is "very unlikely"

major conflagration—especially from the British Gas terminal. First the "general effect of the improved dense gas dispersion model developed by SRD . . . has reduced the estimated hazardous range (while increasing the plume width) of flammable and toxic gas releases".

Secondly, the SRD has switched to a "best estimate" approach when assessing the effects of accidental releases rather than the "conservative approach" of assuming the worst, which it employed in its previous survey of hazards on Canvey Island for the 1978 report. Thirdly, the HSE thinks the prospect of a spill of 10 000 tonnes of methane from a ship accident at the methane terminal is now "very unlikely". Its effects, which could include an explosive cloud up to 10 kilometres long, according to the previous report, are discounted in the new risk assessment. HSE now thinks a 1000-tonne spill is the worst likely.

The effect of all this is to reduce vastly the HSE's estimate of the chances of a major accident involving thousands of casualties. The risk of an accident killing 4500 people is reduced by 30 times—from 927 chances in a million to 34 chances in a million. This compares with the risk of an accident that would kill 10 people near the site of the accident, which, says the HSE, has fallen by 4², times since 1978. The report says: "Experience seems to show that the full lethal potential of a major industrial accident is most unlikely to be realised"; the reassessment has reflected this by reducing considerably the risk of accidents with over 1500 casualties.

In the face of these claimed reductions in risk, the HSE now offers no opposition to plans for expansion, in the Canvey area, for example at Mobil, where a new unit handling hydrogen fluoride will double the risk of an accident in the refinery killing 10 people outside. And it supports the continued operation of the British Gas methane terminal.

The report ignores a key recommendation made by General Sir Richard Ward, the inspector at an inquiry held

earlier this year into a plan for a new oil refinery in the area. Ward said that a fool-proof method of stopping an explosive cloud spreading from British Gas's methane terminal should be found. Otherwise the terminal should close. One proposal was for a series of flares round the perimeter fence which would ignite any cloud before it spread. It might destroy the terminal and kill some workers, but it would save the Canvey Islanders.

The HSE is bound to meet a barrage of protests from residents over its new assessment at next January's inquiry. The protesters claim the HSE's analysis omits the following important factors:

- **Terrorism.** In 1979 the IRA left a bomb next to a Texaco oil tank on the island. It did not go off, but residents say terrorism is a risk that should be taken into account.

- **Occidental** has half-built a giant refinery at Canvey. It was mothballed in 1978 but the company now says it hopes to restart building. The HSE ignored risks from the refinery in its new assessment. In 1978 it said the refinery would have a 140 in a million chance of killing 4500 people each year.

- **Murphy's Law.** Residents say the hazard survey takes no account of bad management and human error. General Ward said of British Gas's methane terminal: "I am not confident that the necessary safety standards will be maintained". And there are strong rumours that a second report to be presented to the inquiry by the HSE's Factory Inspectorate will reveal dozens of examples of poor management, faulty equipment and sloppy maintenance there.

- **Hazard surveys.** Many of the hazard surveys which have revealed smaller risks at plants have been conducted by the companies who own the plants. Sometimes the details remain secret. In March 1979, British Gas gave the HSE a report showing that the likelihood of its liquefied methane tanks overflowing had been over-estimated in the original HSE report. The HSE produced its own revised assessment in September 1979. Neither investigation discovered that, during that year, crucial alarm systems designed to warn of overfilling tanks were not working.

This revelation—which brought three enforcement notices from the HSE demanding emergency repairs—came only after a former British Gas employee told the executive the truth a year later.

And last week at least one party to this embarrassing incident appeared aware of a need to brush up its image—British Gas was giving its methane terminal a new coat of paint. □

Observer



"Can this be mild-mannered
Bruce Kent?"

THIS WEEK

At last physicists trap the quark—or have they?

ITALIAN physicists at CERN, Europe's centre for nuclear research, have found some strange effects that may be due to the elusive free quarks that physicists the world over are hunting. They are asking for more time on CERN's accelerator to investigate their discovery further.

Quarks are the supposed building blocks of larger sub-atomic particles such as neutrons and protons. Although there is evidence to suggest that protons and the like are indeed made from smaller objects, no one has yet seen a quark on its own.

The Italians at CERN, led by Professor Antonio Zichichi, have been looking for quarks in the debris of collisions of high-energy neutrinos in a target of 23 tonnes of lead. The neutrinos, tiny neutral particles that possess little or no mass, are produced at CERN's Super Proton Synchrotron. They interact only very weakly with matter—hence the large lead target—and do not show up in the ordinary particle detectors that physicists use. However, in those instances where a neutrino does interact with an atomic nucleus in the lead target, detectors "downstream" of the target will pick up any electrically-charged debris knocked off in the interaction.

The main detector Zichichi's group has been using is an avalanche chamber—basically a box containing a suitable gas mixture in a very high electric field.



Are quarks on the prowl inside the Super Proton Synchrotron?

Charged particles passing through the chamber ionise the gas, which then breaks down along the tracks of the particles, producing small sparks. The amount of ionisation is proportional to the charge of the particle—and charge is the crucial factor in the search.

Christine Sutton

One of the most unusual things about quarks is that physicists think they possess electrical charges that are fractions of the charge on the electron. All other particles have charges that are integral multiples of the electron's charge, or are neutral. But, for protons and neutrons to be built from three quarks as theory suggests, then quarks must carry charges either $\frac{1}{3}$ or $\frac{2}{3}$ that of the electron.

Britain needs biotechnology jobs to stop brain drain

IN A REPORT which is about to be published the Royal Society says the University Grants Committee should urgently create 20 new university posts for biotechnologists. The document also predicts that Britain will need 1000 extra graduates and 4000 more technicians in biotechnology by the 1990s.

The Royal Society says in the report on biotechnology and education that, in view of the importance of biotechnology as a future source of jobs and wealth, government departments should formulate a national policy on education and, if necessary, transfer resources from elsewhere to satisfy Britain's needs. This is particularly important, the report says, because there are signs that the brain drain to other European countries and the United States might become "serious".

The government's reluctance to do anything about creating the 20 extra posts, a move recommended more than

a year ago by a prestigious advisory group chaired by Dr Alfred Spinks, has infuriated biotechnologists. In its White Paper in response to the Spinks report, the government argued that the likely demands of biotechnology could be met within the existing educational framework. It made no mention of the 20 extra university posts the Spinks report demanded.

Britain's biotechnologists argue that these extra posts are needed to strengthen existing centres of excellence and to prevent the dissipation of resources among universities that might result from colleges without any expertise in biotechnology climbing on the bandwagon.

Last week, biotechnologists at a closed meeting of the British Coordinating Committee for Biotechnology confronted representatives of the Department of Industry and the University Grants Committee (UGC) with a demand that the government should take action to provide the 20 extra posts.

The biotechnologists want the UGC to claw back money it will save as a result of its recent cuts in university funding and reallocate the cash specifically for biotechnology. Their committee now plans to make special representation to the government to argue its demand.

The question of the extra posts was

The amount a particle ionises a material depends on the square of its charge, so in searching for quarks physicists look for particles that produce $\frac{1}{3}$ or $\frac{2}{3}$ the ionisation of electrons. Clearly ionisation $\frac{1}{3}$ that of an electron will be the easiest to spot—and this is just what the Italian physicists appear to have found in three instances, out of some 300 000 interactions they have observed at CERN.

But there are problems with these three events, and this is why the physicists are asking for more time on the Super Proton Synchrotron to collect more data. Indeed, Zichichi is careful not to mention quarks in discussing the data his team has collected so far. The main difficulty is that, although the tracks in the avalanche chamber indicate particles with a charge of $\frac{1}{3}$ the electron charge, other counters, used for timing measurements and so on do not show anything unusual for these particles. Thus, as Zichichi points out, what they may be seeing is some new phenomenon in the avalanche chamber rather than some new phenomenon in the world of particle physics.

If Zichichi's group has indeed, at last found free quarks, the problems for physicists will not be over: they will then have to explain why all previous searches for quarks have failed. And what is so special about neutrinos that they should sequester quarks out of their parent particles? □

not the only part of the government's White Paper to which the Royal Society takes exception. The White Paper predicted that Britain's flexible educational system would allow local colleges to devise courses to meet employers' needs for technicians in biotechnology. The Royal Society now points out that "because of social pressures in favour of honours degrees, the down-graded status of many technicians, and the disastrous decline in sandwich course placements," the number of technicians in training is too low. Although the number of courses (and places on them) is adequate, extra resources will be needed to attract technicians to these courses.

In line with the Spinks report, the Royal Society does not believe that biotechnology should be taught as a separate subject at any level in the educational system. Schools should try harder to make pupils aware of biotechnology and to set more appropriate school curricula. At university, biotechnology education should still be based mainly on traditional courses in biology and chemical engineering.

The report recommends three-year courses with a postgraduate conversion course or a four-year course with substantial "practical elements" as best suited to the needs of the new discipline. □

Genes at work



THIS WEEK

Government 'heartless' about computers for disabled

GOVERNMENT schemes to help schools use computers fail to meet the needs of children who are physically or mentally handicapped, say education specialists. Teachers say computers can play a big part in helping disabled children to learn or to communicate with other people. But the government is not giving teachers the money they need to adapt computers for the disabled—especially by writing new software.

The Department of Education and Science (DES) is spending £9 million over four years to encourage schools to use computers. The scheme, which civil servants first mooted in 1978, is only now limping into action. Officials are setting up regional centres, based on groups of local authorities, to serve the country's 25 000 primary and 8000 secondary schools.

X-rays bring relief to arthritis

HELP could be on the way for sufferers crippled by rheumatoid arthritis, if the results of two studies reported in last week's *New England Journal of Medicine* are confirmed by more intensive research now under way. The studies showed that patients treated by irradiating their lymph nodes with X-rays improved markedly.

Doctors use similar X-ray treatments to attack Hodgkin's disease, cancer of the lymph nodes. Lymph nodes are glands that filter invading bacteria from lymph as well as manufacturing white blood cells and antibiotics. If it is to work properly, the immune system of which lymph nodes are a part must have some way of distinguishing "foreign" material to be attacked from the body's own tissues. Rheumatoid arthritis is probably the result of a breakdown in the immune system's ability to recognise the body's own tissues—the system attacks the tissues surrounding joints, producing the stiffness and pain characteristic of arthritis.

Two groups of researchers claim some success for the X-ray treatment—one at the Brigham and Women's Hospital in Boston, the other at the Stanford University Medical Center in California. During the therapy, most of the patients they treated noticed that their joints became less stiff: a month later, symptoms started to disappear.

Of 11 patients the Stanford researchers treated, 9 reported a marked improvement, as did 8 of the 10 treated at the Brigham and Women's Hospital. The Boston researchers kept in touch with 6 of their patients for more than a year; although all 6 suffered a recurrence of their arthritis, 5 of them were better than they were before treatment. □



Hope for the handicapped—at a price

But teachers in Britain's 1600 special schools for the handicapped fear that children there are getting a rough deal. The DES has earmarked only £500 000 to

Peter Marsh

help put computers into the special schools—about 70 per cent of the money is for children who are mentally handicapped or educationally sub-normal, and the rest is for the physically handicapped. The money will support four centres with staff to show teachers in the special schools how to use new computer equipment and software. The scheme will also pay for two consultants.

However, researchers who are designing electronic aids for handicapped children believe that these arrangements will prove inadequate. Mary Hope, who

works at the government-sponsored Centre for Educational Technology and is coordinating the special schools' scheme, said: "There are a lot more things that we could do if we had the money. We're going to highlight a lot of problems but solve few of them." She says that the main problem is suitable software.

Phil Odor, a researcher at Edinburgh University, who is one of the scheme's two consultants, says that the government should concentrate on interface switches that would

allow people with handicaps to communicate with computers. These switches, operated by feet or fingers, give the handicapped the chance to use a range of ordinary computers such as Apples or Pets. What is needed, says Odor, is a better way of coordinating the efforts of the researchers who are studying this problem. He thinks the government is being "heartless".

The Inner London Education Authority is one of the leaders in using computers in schools for the physically handicapped. One ILEA teacher working on this project, Edna Nichol, said: "Computers are useful aids for normal children but they are not absolutely essential. For some disabled children, computers mean that, at long last, they can be educated to the limit of their abilities". □

The return of the skull

A DISTINGUISHED old Kenyan returned to Nairobi this week after more than 30 years in London. He (or she) is *Proconsul africana*, the skull of an 18 million-year-old creature more like an ape than man, which the renowned anthropologist Mary Leakey discovered in 1948. She took the skull to London in 1949 where it caused great excitement as a primate not very distant from man. Later discoveries showed that the relationship was not quite so clear-cut, but *Proconsul* remains by far the best specimen of its type.

The skull became a bone of contention when the British Museum (Natural History) classified it as part of its permanent collection rather than simply on loan. The Kenyans, who wanted to install *Proconsul* in Nairobi's National Museum, saw this as an act of colonial plunder (*New Scientist*, vol 88, p 245). Luckily, after an expedition into the wilds of the Kenya National Archive, officials from the museum found letters documenting discussions between Louis Leakey, then director of the museum, three British academics, and more importantly the colonial government of Kenya. In particular, a letter written in 1949 by the acting chief secretary of Kenya Colony to Leakey states that the skull may "... be housed in London for the time being . . . on the clear understanding



Leakey displays her find

that the Kenya government retains ownership and reserves the right at some future date to resume possession".

With the evidence on paper, the Kenya government made a formal request for *Proconsul's* return. Fortunately for relations between the two countries, the trustees of the British Museum agreed that the specimen had been "accessioned" in error. "This is definitely not a restitution issue," a spokesman said, "it was here for study purposes . . . it has simply taken an extraordinary length of time to discover that it was not part of the collection."

Last Friday the museum handed over the skull to a representative from Nairobi, so *Proconsul africana* should soon be home again. □

THIS WEEK

Paranormal-watchers fall out over the Mars effect

THE American Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP) has denied accusations of fraud and cover-up over its investigation of French neo-astrologer Michel Gauquelin. CSICOP's council met last week in Toronto and affirmed its faith in the conduct of chairman Paul Kurtz and others connected with the Gauquelin investigation.

The accusations came from Dennis Rawlins, an expert on planetary motion and former member of the committee's council. Rawlins says, in a long article in *Fate* magazine, that CSICOP "bungled their major investigation, falsified the results, covered up their errors, and gave the boot to a colleague who threatened to tell the truth."

Kurtz, professor of philosophy at State University of New York at Buffalo, counters: "There's no truth to that." He told *New Scientist* that Rawlins was mistaken and deluded. "He attacked everyone on the council. We could not work with him. This was the reason he was removed from the council."

The row goes back to before 1976 when Buffalo statistician Marvin Zelen used the pages of *The Humanist* to issue a "challenge" to Michel Gauquelin. Gauquelin had astonished astrologers and scientists by offering evidence of a clear planetary effect on human behaviour. Champion sportsmen, Gauquelin said, were unusually likely to have been born just as the planet Mars was rising or shortly after it had passed the zenith. Mars was in those two sectors for 22 per cent of champion sportsmen, rather than the 17 per cent expected by chance. (The Mars effect is merely the strongest of the many links that Gauquelin has uncovered between planetary position and profession.)

Zelen's challenge was for Gauquelin to compare the Mars data for his champions with data for ordinary people born at the same place on the same day. This would control for possible demographic effects—Mars spends a disproportionate amount of time in certain sectors and more births could be occurring then among future champions and non-champions alike. Zelen claimed that he was providing "an objective way for unambiguous corroboration or disconfirmation."

Rawlins discovered that Gauquelin had indeed taken account of this source of error, and says he warned members of the newly formed CSICOP that the Zelen test would not be unambiguous. He says he urged CSICOP to abandon it.



Did Mars help Coe beat Ovett?

Courtesy of AP

Kurtz, formerly editor of *The Humanist*, told *New Scientist* that this was untrue. "CSICOP did not hear from him until after the test was under way, perhaps a year later." Gauquelin himself did the computation for the Zelen test, which came out in Gauquelin's favour.

Later Zelen split the sample of champion athletes Gauquelin had compiled into

Jeremy Cherfas

subgroups and found the Mars effect was strong only in Paris, and did not show in the rest of France or in Belgium. By this time an independent test of Gauquelin's claims was under way using a new sample of US sports champions. Rawlins did the computations for this test, which certainly did not support Gauquelin. This time it was Gauquelin who was able to come up with subsamples that supported his claim. According to Kurtz, Rawlins turned on the committee when he was not invited to write the report of that test.

In his *Fate* article, Rawlins makes a number of other allegations about the conduct of Kurtz and other members of CSICOP, who have responded by pointing out "falsehoods" and "inconsistencies" in Rawlins's account. But the central issue, of whether the committee badly mishandled the original Zelen test of Gauquelin, is not answered.

Phillip Klass, a CSICOP council member who has been brought in "to sort it

all out", said: "if we could turn back the clock we might do things differently". Kurtz does not deny that the Zelen test went in Gauquelin's favour, but nor is he ready to admit that the committee mishandled it.

The task CSICOP is taking is to deny that the tests of Gauquelin were ever CSICOP affairs. James "The Amazing" Randi, a council member and scourge of paranormal fraudsters, says the Gauquelin tests "are not, and never have been a committee project". But Piet Hein Hoebens, a Dutch paranormal-watcher, points out that "the persons criticised by Dennis Rawlins . . . and CSICOP may be two different groups, but they certainly overlap to such an extent that the uncommitted outsider will find it hard to tell the difference". In any case, Randi concedes that Rawlins "has a case, to a limited extent".

The effect of Rawlins's accusations and the methods adopted by CSICOP to refute them, must affect the committee's public standing. "I certainly cannot enhance our reputation," says Klass. He brought up an earlier incident,

in which Rawlins tried to get a University of Toronto meeting on astrology stopped. This episode had "a sure negative effect on the committee, especially as Rawlins seemingly was one of us," Klass says. "We should have told Dennis Rawlins then to issue a public announcement saying that it was a personal endeavour, and expelled him if he did not." The next outburst, Klass feels, will have the same bad effect on CSICOP.

CSICOP's council met on 2 October in Toronto to discuss this and other matters. The issue of Kurtz's resignation was mentioned by some people. New Scientist spoke to James Randi says "it's about time we had a succession," but fears that "the psychic press" would have a field day if Kurtz were to go.

Rawlins himself says that he has no wish to see CSICOP disbanded. "There's no other game in town," he says, "so I hope they'll reform."

Where Gauquelin's effect stands in all this is not clear. The US test, the one in which Gauquelin did not select the sample or do the calculations, failed to support him. Members of the French branch of CSICOP are reported to have begun a totally independent test of the Mars effect, from scratch. But Kurtz questions the worth of even more investigation. "We spent five years working with Gauquelin as carefully and cooperatively as we know how. How much further do you go?" □

THIS WEEK

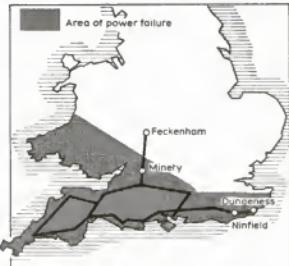
Electricity board still worried about Black Wednesday

TWO fast-growing trees laid low a large chunk of Britain's electricity grid one day last August, cutting off 1.5 million consumers in southern and south-west England in an incident that is still worrying an internal board of inquiry.

The probe is headed by Jim Craig, director-general of the Central Electricity Generating Board's north-western region. Craig held a meeting of the board this week but does not expect to finalise his report until 16 November. Although the inquiry is private, there is now little doubt about how the worst fault in the grid for 20 years happened.

At 9.08 am on 5 August, one of the hottest, most humid and windless days of the summer, a sagging 400 kilovolt "supergrid" line carrying electricity from the Midlands to the Bristol area flashed to Earth through a tree between Feckenham and Minety. Although unusual, this is not exceptional. What happens normally is that circuit breakers turn the current off for a few seconds and then automatically restore the supply. Most faults clear themselves. But on this occasion the ionised path to Earth was maintained by the comparatively short distance to Earth and the weather.

The tree, now burning, added its quota of ions to aid the path, and after attempts to reclose, the circuit breakers "locked out".



Even this would not be remarkable but for the fact that two minutes later, at 9.10 am, and 240 km away as the crow flies, another tree between Dungeness in Kent and Ninefield in East Sussex caused a similar fault, tripping out another 400 kV supergrid line feeding the south coast and the South-West right down to Cornwall.

By 9.18 am, the remaining 400 kV line carrying power to the South-West was overloaded and cut out between West Weybridge and Bramley. The grid fell apart. In the words of a CEBG spokesman, the frequency of the supply went potty. As the frequency fell and other parts of the grid tripped out, power

stations in the South and South-West struggled to meet what demand they could. But about one-third of the consumers in the areas affected lost supplies for between 30 and 90 minutes until established emergency procedures restored the interconnected grid by 11 am.

Confining the trouble to the south west of England, South Wales, the south coast and parts of the South-East was a vindication of the grid system for the whole of England and Wales, and a tribute to engineers who reacted promptly to restore supplies.

But while "Black Wednesday" was not on the scale of blackouts in North America, it is nevertheless disturbing that it took only two trees to cut off supplies to 1.5 million customers.

The electricity board's chairman, Glyn England, was going to confirm all this last week when he presented "good housekeeping" prizes to transmission engineers in Doncaster. He had planned to say that the incident underlined the vital part that linemen play in the network and how they are the eyes of the generating board in the field. But at the last moment, England changed his speech and talked about saving money instead. Apparently he thought it might be invidious to tell linemen in Yorkshire to keep careful watch when the faults in question happened hundreds of kilometres away.

Soon after Black Wednesday, the CEBG sent a brief two-page report to the Department of Energy which described what happened, but made no recommendations about the adequacy of tree clearances or the frequency of route inspections.

The original fault was on a line carrying 900 megawatts which should have been well within its summer maximum capacity of 1050 MW, but because of increased efforts to minimise the use of oil-fired power stations in the South-West, Black Wednesday may have been the first time that the load was as high as this in hot weather.

Jim Craig's board of inquiry which has moved from mainly managerial questions to more technical issues, will make recommendations about the layout of control rooms and diagrams used in transmission control rooms.

The CEBG believes that the incident strengthens its case for another power station in the South-West, and hence its insistence on wanting to rid the Luxulyan site in Cornwall, one of six under consideration, of anti-nuclear protesters. On 5 August, demand in the South-West was 4500 MW while the region's power stations generated 2750 MW. The difference was made up by imports from the Midlands and further north from the big, efficient coal-fired stations on the Trent Valley and in Yorkshire. This state of affairs will continue until more power stations are built in the South-West, says the board. □

Blood business gets a shot in the arm

BRITAIN'S Treasury has approved a plan to spend £17 million on a "blood factory" that could save the country money in future. The factory will separate and purify proteins in human blood essential for the treatment of burns and diseases such as haemophilia.

The Treasury took four years to make up its mind about the factory. The main worry was whether advances in genetic engineering would make the plant obsolete before it could pay for itself. Among the many proteins in human plasma (blood with the red cells removed), albumin and factor VIII are the most important. Albumin is a useful "blood expander" for burns patients who have lost a lot of fluid. Factor VIII promotes blood clotting, and is one of the proteins missing in people who suffer from haemophilia.

Britain imports at least half of the plasma proteins that the health service needs, largely from the US. This is expensive—about £10 million a year—and American blood, from paid donors, is often contaminated. Imported plasma proteins go to the Blood Producing Laboratory of the National Blood Trans-

fusion Service at Elstree near London for processing. But inspectors have criticised the laboratory as obsolete and unsafe. Although the government has spent £1.2 million patching up the laboratory, everyone agrees that a new plant is necessary.

The blood transfusion service set up a working party to tackle the complicated problem of selecting the correct technology. One option was to follow the American example and turn to genetic engineering. In the US many scientists at universities and drug companies are trying to alter bacteria genetically to make human proteins such as albumin or factor VIII.

The British opted for more traditional technology. But could the factory be built quickly enough to recoup its costs before the genetic engineers broke through with a commercial product? An engineer on one of the working parties set up to consider the issue estimated that if the factory were built within three years it could recoup its costs in 15 months.

The biggest problem, says a lecturer in biotechnology on the working party, will be to build the plant in such a short time. Industrialists on the working party urged the government to build quickly, he says, whereas the Department of Health "understands" the Treasury's "point of view" that trying to speed up too much could cost a lot of extra money. □



THIS WEEK

Shuttle takes off—and a piece of Britain goes with it



After a delay of a month, Columbia, NASA's space shuttle, is set to take off next Wednesday on its second flight. On board during the five-day mission

will be two astronauts, Joe Engle and Richard Truly, who are making their first trips into space. But British eyes will be focused on a piece of hardware in the craft's payload bay—a 3-metre-long rack made by British Aerospace which will carry a set of five scientific experiments 83 times round the world.

The experiments, plus two others in the vehicle's crew cabin, will be the first real test of the shuttle's usefulness. The craft's first flight, in April, lasted two days and proved only that it could get off the ground and land safely.

On the second flight, which was delayed after fuel leaked out of the vehicle and damaged some of its heat-resistant tiles, the astronauts' main job will be to test a new and important piece of equipment: a 15-metre mechanical arm that, on future missions, will re-

lease payloads (such as satellites) into space. The Canadian-built arm is articulated like a human limb and can lift objects as heavy as 30 kilograms. In future, the shuttle's computers will operate the arm automatically; but, on this flight, Engle and Truly will manoeuvre it themselves from the flight deck. The arm, built for NASA by the National Research Council of Canada, cost about £50 million.

Apart from putting the arm through its paces, the high spot for the astronauts will occur when Engle dons a spacesuit and tests the procedures for

Peter Marsh and Mark Hewish

leaving the craft during a flight. Engle, a former Air Force pilot who waited 15 years for his first trip beyond the Earth's atmosphere, will stop just short of making a "space walk".

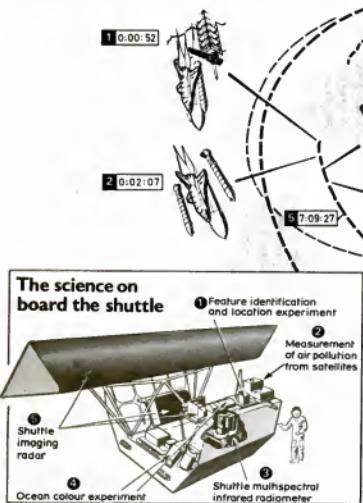
The scientific experiments themselves will not take up much of the astronauts' time. They will function mainly automatically. According to NASA, Engle and Truly will just have to press a few buttons and spend most of the journey enjoying the ride.

NASA's Office of Space and Terrestrial Applications chose the experiments on

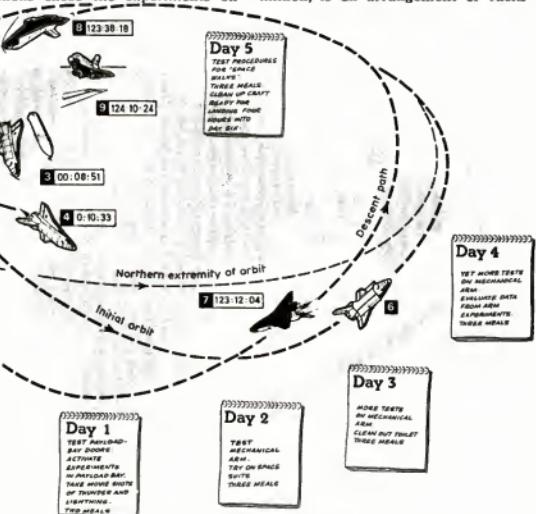
Columbia. Those in the shuttle's payload bay—which will be out of bounds for the astronauts during the flight—will either scan the Earth as the shuttle passes over it at a height of 253 km or measure gases in the atmosphere.

The two other experiments are in the astronauts' living quarters where, from time to time, Engle and Truly will take on the role of amateur movie enthusiasts. They will take pictures of thunderstorms and lightning flashes; scientists will later analyse the results to find out more about the Earth's weather. In the other experiment on board the spacecraft, technicians will stow a few sunflower seeds in one of the crew's lockers. These are not for the astronauts in case they require extra rations during the trip; rather, scientists will measure how the seeds grow in space and how much water they need.

The rack which carries the experiments in the payload bay is, to European eyes, the most important piece of equipment on board. The European Space Agency provided the U-shaped rack; similar devices will form part of Spacelab missions when they start in 1983. Spacelab, which cost the agency £500 million, is an arrangement of racks ►



The shuttle will carry five experiments in its payload bay. They will help sensors such as radar to select areas of the Earth from which to take data (1); measure the distribution of carbon monoxide in the troposphere (2); record spectral "signatures" of rocks to identify mineral deposits (3); map areas of the oceans that support algae (4); and obtain geological data (5).



After taking off from Cape Canaveral (1), the shuttle jettisons its solid-fuel boosters after some 2 minutes (2). The external tank goes next (3). A series of manoeuvres follows (4-5) to stabilise the craft in its orbit some 220 km above the Earth. During the space voyage proper (6), the astronauts have relatively little to do. After 82 orbits, the craft dives toward Earth (7), enters the atmosphere (8) and lands on a dry lake in California (9).

THIS WEEK

◀ together with an optional large aluminium container in which people can live) that the shuttle will take into space for up to a week at a time.

Next week's mission will record how well the rack performs in space; it should also give engineers data about the ways in which they could adapt the device to a free-flying pallet that could exist outside the shuttle's payload bay. Space engineers believe that such small and reasonably cheap modules could be the best way of leaving scientific experiments in space for long periods.

At Cape Canaveral, NASA's engineers have modified the launch pad to try and avoid damage on lift-off. Last April, the hot and fast-moving exhaust gases from Columbia's two solid-fuel booster rockets bounced off the bottom of two wells in the launch platform and put about four times too much pressure on the orbiter's rear heat shield. The shuttle was not damaged, but the vibration could have harmed delicate experiments in the payload bay, if Columbia had been carrying any.

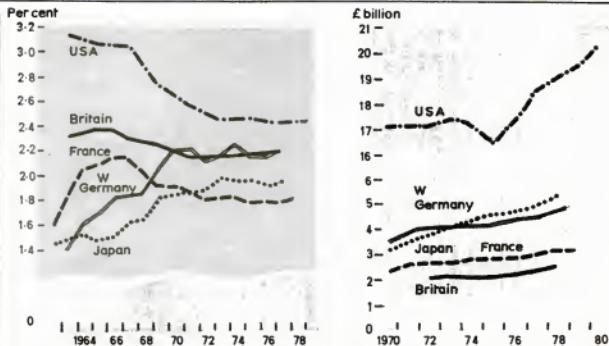
During the second flight Columbia will carry delicate instruments so NASA has developed a "belt and braces" solution to the problem. Troughs of water will partly cover the entrances to the two wells in the launch platform and stop the exhaust shock wave from bouncing back. The second line of defence is to spray high pressure water from jets about a metre below the rocket nozzles. These should break up the gas flow.

NASA may also encounter problems later with Columbia's own three liquid propellant rocket engines. The orbiter itself is supposed to last for 100 flights, but the engines will have to be replaced at least once in the orbiter's lifetime. The engines were run on full power on the first flight. But NASA wants even more power, so it will "overspeed" the engines to produce 102 per cent of their design "maximum" on the third mission. This will eventually build up to 109 per cent on future missions, which will shorten their life.

NASA plans an operational fleet of four shuttles. It asked for a fifth vehicle in the 1982 budget, but President Reagan's cuts delayed the plan. Jerry Bostick, manager of the shuttle programme, said in London last week that his office will ask again for the fifth orbiter next year.

Demand for the shuttle has increased since its first flight, according to Bostick, and he believes that even the present level of interest will require at least eight orbiters.

All the shuttle flights until 1987 have already been booked. The schedule has had to be reorganised following Reagan's cuts, but present plans call for the third mission to carry a "getaway special"—a small payload package that fits around the main payload—as well as a NASA experiment carrying sensors to look out into space. The fourth flight will be devoted to a US Department of Defense experiment. □



The proportion of its annual income Britain spends on R&D seems to compare well with other industrial countries. But its income is so small, in comparison, that the amount it actually spends is well below any other country

Government meanness on research slammed

IF BRITAIN has a strategy for research and development, you would be hard put to find out what it is. According to two reports commissioned by the government, R&D in Britain is on too small a scale, undirected, and takes no account of what industry wants or customers for industrial goods need. Both reports—one by the National Economic Development Council (NEDC) and the other by a task force set up by the Department of Environment and the Science and Engineering Research Council—slam the government for the meanness of Britain's research effort.

The NEDC's report finds that Britain spends about half as much on R&D—both public and private—as do its main industrial competitors, West Germany and Japan, and considerably less than the US. Britain does spend about the same proportion of its gross national product on research as West Germany (and more than France or Japan), but the report says this statistic hides further horrors, and is not in any way reassuring.

First, 55 per cent of the money Britain spends on R&D goes to defence, largely for aerospace and electronics. But, unlike other industrialised countries, Britain gains little "spin-off" for industry from publicly-funded defence research. This has led to Britain's electronics and electrical engineering industry being the only sector of industry that imports a significant proportion of its technology, while having more public R&D money lavished on it than any other.

The report repeats an old saw that one of the most important constraints on growth in British industry is its sluggishness in adapting to change. The smallness of Britain's gross domestic product compared with those of rival nations, accounts for the low figure for overall R&D spending.

The NEDC's report calls for more

government spending on R&D, noting that Britain's rivals in Europe are putting more and more emphasis on innovation and new technologies. But more money on its own will not be enough. The government should, says the NEDC, decide priorities for R&D spending in each area, to make the most of potential markets and the availability of new technologies and processes. It should ensure that the results of defence R&D filter through to private industry, as happens in the US.

In the other report, a task force headed by Alan Muir Wood (of the engineering consultants Sir William Halcrow and Partners) slams the Department of Environment for the inadequacy of research on building. The construction industry is one of Britain's biggest, with a turnover of £19 thousand million a year, and earns more than £1000 million a year in foreign exchange. Yet it spends only £100 million on R&D—0.5 per cent of the total spent on construction in Britain.

The government is the customer for 50 per cent of construction work (and 80 per cent of civil engineering) in Britain, so there seems little doubt who is to blame for the minuscule spending on R&D.

But Muir Wood's report does not stop there. The way the government has handled the construction industry in the past 15 years—as a kind of economic regulator—has resulted in so many changes of policy and styles of management that it has effectively excluded the industry from participating in decisions about R&D. Muir Wood's committee says there should be a hard core of fundamental and forward-looking building research, and a mechanism for directing this basic R&D. The task force is also critical of the way cuts in government spending have curtailed vital long-term strategic R&D. □

THIS WEEK

Britain accepts second-best controls on new chemicals

GOVERNMENT scientists have lost a Whitehall battle to introduce tough new rules to force industry to screen for safety the hundreds of new chemicals made every year. The new tests would pick out chemicals that affected workers or damaged the environment. Lobbying by the chemical industry has persuaded ministers not to introduce the rules that the Health and Safety Commission proposed in February 1980. The government will, however, implement — several months later — an EEC directive controlling the introduction of new chemicals. But the EEC's directive will apply to fewer chemicals. And government scientists say that there is not enough scientific manpower even to put this limited scheme into practice properly.

The Chemical Industries Association was the strongest opponent of the Health and Safety Commission's proposals. It said the rules the commission suggested would mean a "significant reduction in innovation" in industry. "Some sections of the industry would contemplate closure" and others would move abroad, because of the expense of conducting the safety tests that the scheme would demand.

The EEC's directive that will now form the basis of British controls, applies to new chemicals made in quantities greater than 1 tonne. But it excludes foodstuffs, pharmaceuticals, pesticides and "intermediates"—chemicals that are mere stepping stones in chemical processes but which could, nevertheless, affect workers or find their way into the environment. The Health and Safety Commission included all these in its scuppered scheme.

Examples of past mistakes that might have been avoided by such a scheme include detergents that are not degraded in the environment and persistent organochlorine pesticides. As part of the 1974 Health and Safety at Work Act, parliament gave the Health and Safety Commission powers to draw up a control scheme. The commission's proposals would have put this parliamentary intent into practice.

One of the men at the centre of the battle about the proposals has been Dr Norman King, deputy chief scientific officer at the Department of the Environment. He recently told a conference of experts on water pollution that he had "considerable doubts" about whether the department has enough scientists to scrutinise the dossiers on the safety of new chemicals that manufacturers will have to submit to the government under the EEC's "notification" plan. "To be fully effective as an early warning scheme," King said, "a more active role



The pills are protected—but what about the workers?

must be assumed by the notification team." But, he said, he has been given only "a handful of staff" to do the job. He pointed out that assessing the information manufacturers will pass on to government will not be easy.

Fred Pearce

"The government now intends to comply with the letter of the directive and not go beyond it," he claimed. Government scientists fear that safety information about new chemicals will languish in computer files, unchecked and with no independent assessment of the danger the chemical presents to workers, the public and the environment.

Under the EEC's directive, the manufacturer or importer of a new chemical that sells more than 1 tonne a year must notify the Department of the Environment and the Health and Safety Executive (HSE) before the chemical goes on sale. The notification must record the chemical's basic properties, impurities, toxic effects, intended uses and recommended precautions in handling, labelling and disposal.

The government can demand more tests—of the chemical's toxic properties—when 10 tonnes are sold. These trials become mandatory when the chemical sells more than 100 tonnes a year. Above 1000 tonnes a year, a panoply of tests is needed—including some to find out whether the chemical causes birth defects or cancer.

The failure of the Health and Safety Commission to persuade industry to accept its own proposals is a rebuff for the commission, which prides itself on its ability to get on well with industry (after all, industry does nominate a third of the commission's members). Last month, it covered its embarrassment by announcing a tripartite "working party" of its appointees, industry and trade unions to resolve the "outstanding issues" not covered by the directive.

"We still hope to get some of our proposals through," said a spokesman. But the working party has no clear remit and nobody in government or industry *New Scientist* talked to last week believed that the commission's major recommendations will now be adopted. The Chemical Industries Association said it was "delighted" that the ideas had been "dropped".

The Health and Safety Executive (the commission's operational arm) is concerned that the absence of controls over pharmaceuticals, foodstuffs and pesticides will endanger workers producing and handling those chemicals. It is also worried by the omission of intermediates from the directive. The production of dyestuffs, for example, involves as many as 10 processes, each resulting in intermediate chemicals to which workers could be exposed. The HSE says that intermediates were removed from the EEC's directive after lobbying by the West German chemical industry.

Another major source of disagreement between the HSE and the chemical industry is the question of the confidentiality of the information on new chemicals that companies will give to the government. The chemical industry argues for very tight controls on information. It does not want government scientists to pass details about chemicals and their potential dangers to agencies that enforce environmental laws, such as the water authorities.

"The whole pattern of commercial innovation depends on certain key information being kept confidential," says the Chemical Industries Association. Here too the industry is likely to win the day when final regulations implementing the EEC's directive are published next year.

King said "I cannot conceive of circumstances where the notification team in the Department of the Environment would have information indicating a potential hazard for a chemical... and fail to act to alert the relevant control authority because of considerations of confidentiality." But Desmond Hamerton, director of the Clyde River Purification Board, said he fears that the confidentiality rules might cause delays, at least.

Meanwhile, British firms still have no idea whether or not they should be notifying the government of new chemicals. The directive—which has power of law in Britain—has been in force since 18 September. But regulations to bring it into British law will not be published until next year. The environment department and the HSE say they are "open for business". In an average month, they might expect 50 notifications. Up to last week they had received none. □

Brandt summit—high hopes, deep despair

Optimists who went to the Brandt summit in Mexico last week left disappointed, but the sceptical came away with more than they had expected



Ziauddin Sardar

It was not "a meeting of the foremost importance in the history of mankind" nor was it the "epoch-making event" that Zenko Suzuki, Prime Minister of Japan suggested. But last week's North-South summit in the plush (but alienating) Mexican holiday resort of Cancun did make progress in resolving the deadlock in the "global round" of talks on the key development issues of food, energy, technology transfer, and structural reforms in global institutions (*New Scientist*, 6 August, p 334). Officially dubbed "the international meeting on cooperation and development", the summit was proposed by the Brandt commission report, published last year. This recommended that a major world summit should be held to provide "a new impetus for future negotiations" between North and South, and launch new initiatives for solving the ever increasing problems of the Third World.

The meeting had no formal agenda, involved no negotiations and did not issue a communiqué. Yet, it brought 22 world leaders together, representing the entire spectrum of opinion at the UN (with the notable exception of the Soviet Union), to discuss the key North-South issues in a "framework of open discussion". If one were to judge the outcome of the two-day meeting by the final statements of the co-chairmen, Mexico's President Jose Lopez Portillo and Pierre Trudeau of Canada, the summit was a global non-event. But that judgement could be both hasty and wrong.

The Cancun summit has provided a new impetus for global negotiations and there seemed to be a consensus amongst the 22 leaders, although clearly not an overwhelming one, to develop some kind of global food strategy to tackle the problem of world hunger and to create an Energy Affiliate of the World Bank to help the developing countries ease their energy problems. Unlike



Co-chairmen of the Cancun meeting, Pierre Trudeau and Jose Lopez Portillo are less than pleased at the outcome. Who is to blame? The hardliners in the West. Who suffers? The poor, like these Bangladeshi children



Granada TV
Camera Press

any UN conference, the Cancun summit produced genuine shifts in the rigid positions of Britain and West Germany. These two countries have been partly responsible for the failure of meetings such as the UN conference on science and technology for development held in Vienna in 1979 and the more recent UN conference on new and renewable energy resources held in Nairobi in August. These gains alone make Cancun a modest success.

Despite the absence of a formal agenda, there was no dispute about the issues that were to be discussed at Cancun. The four central issues debated were: strengthening the world's "food security" and assistance to developing countries; mobilising additional resources for investments in the exploration and development of new and alternative sources of energy for the Third World; halting and reversing protectionist trends and stabilising markets for raw materials; and breaking the deadlock in the North-South global negotiations.

Delegates showed considerable concern about the world's shortage of food. President Shehu Shagari of Nigeria told the meeting that some 26 African countries are experiencing deep crises over food. Since the 1970s, agriculture has failed to produce sufficient food for the population of Africa, the overall rate of growth in production in the 1970s being less than 1.5 per cent. Considering the population increases in Africa, "the average African today is in the unenviable position of getting along with 50 per cent less food than 10 years ago. Average food rations have fallen below the vital minimum." Africa's bill for importing food is expected to reach \$125 million per country per annum in 1990 and \$216 million by the year 2000, by which time Africa's aggregate bill for importing cereals alone would reach \$8.6 thousand million.

Shagari called for a strategy to bring about an immediate improvement in food supplies in Africa and to lay



other causes", and an extra \$10 thousand million a year in aid for Africa he said. "This amount, when compared to the more than \$500 thousand million currently being spent a year on armaments for destructive purposes, hardly needs to be justified."

Shagari clearly had an impact at Cancun. Besides proposing to develop a global food strategy, the summit suggested that assistance for the International Fund for Agricultural Development should be increased, efforts should be made to promote agricultural productivity (presumably by promoting agricultural research and development in the Third World), and there should be new negotiations for an international agreement on wheat. President Reagan even suggested that teams of American farmers should be sent to the developing countries to help in improving productivity.

On the whole, the Cancun meeting considered food aid to be a stop-gap measure. There was much more emphasis on promoting agricultural development in the Third World by establishing highly productive and labour-intensive agriculture. Thorbjorn Falldin, Sweden's Prime Minister, warned that the goal of increasing food production—rapidly, substantially and durably—should not overlook the ecological aspects of agriculture. "If this is not done the result will be deforestation, desertification and, in the long run, decreased food production," he said.

More money for energy

Austria, Mexico, France and West Germany called for an Energy Affiliate to the World Bank; this, in theory, would direct increased funds to new energy projects in developing countries. Britain had held out against this suggestion at the Nairobi energy conference but at Cancun, Margaret Thatcher told the summit, "assuming this would attract additional funds which would not otherwise go to the World Bank, particularly from the oil-surplus countries, we will gladly support it". This move effectively isolated the US which, in the name of "private enterprise", has blocked all moves to establish the Energy Affiliate. The OPEC countries responded coolly to the implication that the developed world would support the Energy Affiliate, because it would attract more oil-money for developing energy.

Throughout the summit, Crown Prince Fahd of Saudi Arabia did not make a single comment. Saudi Arabia is already supporting the World Bank to the tune of \$3 thousand million, and the International Monetary Fund to the tune of \$8 thousand million. Sheikh Mohammed Abu Alkhail, Saudi's minister of finance and national economy, announced at the summit that, in the spring, Saudi Arabia made an additional \$10 thousand million available to the IMF. The attitude of Saudi Arabia and other Arab-OPEC countries is that the Energy Affiliate is yet another attempt to get them to put more money into Third World development, without the Western countries fulfilling their responsibilities. Unlike President Francois Mitterrand,

the foundations for a more self-reliant and a more economically viable and integrated Africa by the year 2000. "This means dealing with the serious situation of chronic shortfall in food production, aggravated by severe periodic shortages due to drought, desertification, soil erosion, inadequate technologies and

Crown Prince Fahd does not see the Energy Affiliate as "the most advanced of all the concrete and meaningful proposals for developing countries", but as a confidence trick.

However, at Cancun it seems that Mexico and Algeria, among others, persuaded Saudi Arabia to take a more serious look at the proposal. A high ranking Saudi official told *New Scientist* that if Northern countries showed some willingness to put some cash into the Energy Affiliate, Saudi Arabia could come around to supporting the proposal. It seems that Saudi Arabia's position is not as rigid as its posture implies. However, the Saudis are concerned with getting the overall North-South negotiations going. Their refusal to discuss the Energy Affiliate probably reflects their concern that there should be a "comprehensive" settlement of a number of North-South issues.

If developed countries improved the international terms of trade by reducing the ways in which they discriminate against exports of raw materials and industrial goods from the Third World, they would greatly improve the foreign currency balances of the developing countries, helping them to pay for vital imports of energy and energy technologies. The Northern countries referred often to "open trade". Hans-Dietrich Genscher, foreign minister of West Germany, told the summit that "open world trade" was essential for Third World development and the economic recovery of many Northern countries. The North "must keep markets open and open them wider for exports goods, in particular manufactured goods from the Third World". This, he argued, would "replace the traditional structure of exchange dating from colonial times according to which developing countries are supplying mainly raw materials and industrialised countries are supplying manufactured goods".

President Ronald Reagan also had a great deal to say about free enterprise and the benefits of commerce. "Far too little world attention has been given to the importance of trade as a key to development," he said. He went on to relate how America has benefited from trade and has grown up to be the "world's largest single market". It was left to Shah Azizur Rahman, prime minister of Bangladesh, to point out that trading jute, Bangladesh's main export, is not quite the same thing as trading technology. The prices of raw materials, with the exception of oil, have been fluctuating and weakening, and recently they have fallen sharply. The cost of technology, and of technological products, have been increasing. The decreasing value of raw materials has meant that the low-income countries have suffered a serious set-back in trade. On the other hand, if some developing countries had not been able to increase the value of their exports of manufactured goods to the industrialised nations in 1970-78 by about \$30 million, the OECD nations would not have been able to increase their own exports to the developing countries by \$90 million in the same period. Trade seems to benefit some people much more than others.

Rahman said that trade needed "liberation" before it could benefit the Third World. But the issue of reforms in the global institutions—the IMF, the World Bank, the General Agreement on Tariffs and Trade (GATT), and various UN bodies—is a sensitive one for the developed countries. Conceding to changes in these institutions would amount to solving the entire *problematique* of development.

Mexico's Lopez Portillo, in his inauguration speech, was forceful about the fact that colonialism was a living, suffocating reality. "Many of the problems of the South, of course, must be imputed to the South, but other structural problems, both restricting and deadly, stem from its relationships with the North" he said. Powerful interests oppose effective reform of global economic and technological institutions. "Everything seems to indicate that, far



Within the air-conditioned Sheraton hotel in Cancun, the world's leaders consider the plight of the poor. Outside, one of the poor does the same

from wishing to design a new system, there is every intention of maintaining, or even turning back the clock on the present system, which has proved to be both inadequate and unfair." But Portillo's words fell on deaf ears.

All the developed countries at Cancun made it plain that they wanted, as they always have, to preserve the integrity of these institutions. Reagan told the meeting that it should "respect the competence, functions and powers of the specialised agencies with the understanding that the decisions reached by these agencies within respective areas of competence are final". In other words, talk of changing the global institutions (the main demand of the Third World) or of new international economic and technological orders will not be entertained by the US. Where the US led, Britain, West Germany, Austria and Sweden followed.

A better deal for the poor

Both the US and Austria had bold plans to secure for the Third World a better deal within present structures. Just before Cancun, Reagan had presented to the World Affairs Council of Philadelphia his masterplan to save the Third World. The plan involves "stimulating trade by opening up markets", "tailoring particular strategies to the specific needs and potential of individual countries and regions". These include: increasing food production in the Third World by increasing its capacity to pursue agricultural research; introducing new methods of plant improvement to develop crops that tolerate adverse soil and climatic conditions; more research on insects and disease; research to increase the efficiency of irrigation; and introducing to the Third World, techniques for producing several crops a year. Reagan also committed the US to increase funding for energy-related activities in the developing countries and promised support for "selected elements of the programme of action of the UN conference on new and renewable energy resources"; these included "intensified energy training programmes for Third World technicians and efforts to help developing countries assess and more efficiently utilise their resources".

Austrian Chancellor, Bruno Kreisky, sent a message to

Mexico calling for a large economic and technological effort to help solve the plight of the Third World. Although unable to attend the meeting due to illness, Kreisky talked of a "grand design" and a "Marshall Plan" a few days before the Cancun meeting.

His suggestion is based on the Marshall Plan carried out by the US immediately after the Second World War, to rescue Europe from the ravages of war. The core of the idea is "an outstanding technical device which never aroused in the European countries the feeling of having a leadership imposed upon them from outside . . . the excellent, and yet so simple idea of 'drawing rights' which meant in substance that states acquired the right to buy from each other, with payments for these purchases forthcoming from the Marshall Plan".

Some development economists, as well as some Third World leaders, have also suggested that the developing countries should have special drawing rights at the IMF. But the similarity between the European case and the plight of the Third World ends here. The Marshall Plan succeeded because Europe was an important part of the world's economic and technological system. The Third World is not, and that is the essential reason for its poverty and technological subservience.

Grand designs apart, what else will Cancun be remembered for?

First, this "international meeting on cooperation and development" will certainly make important inputs in the North-South negotiations. Quite apart from the fact that there will now be renewed efforts to get the "global round of negotiations" back to the UN, even cynics must agree that a unanimous political will has been expressed to take steps to improve the effectiveness of food security mechanisms, and develop a long-term programme geared to the elimination of hunger by the year 2000. Both North and South have called for a new international wheat agreement and many developed countries—not just the US—have promised to provide capital to assist developing countries in agricultural research and development. If the verbal support given to creating an Energy Affiliate of the World Bank is translated into action, it would be a considerable step towards relieving the energy burden of the least developed countries.

All this is not earth-shattering, but in North-South terms it is progress. Those, like India's prime minister, Indira Ghandi, who came with no expectations, were satisfied with the outcome. Others who had higher expectations, like Pierre Trudeau, were far from satisfied. Clearly, as Gerhard Thiebach (who was on the staff of the Brandt commission) told *New Scientist*, members of the commission expected the summit to be much more productive and come out with real agreements and commitments.

But given two days and 22 world leaders, and the inherent problem that the outcome of the meeting was constrained by the attitude of the most restrictive member

of the summit, the US, the Cancun meeting has been reasonably productive. Both Britain and West Germany—two of the hardliners—have come that much closer to the Third World. And it has proved that the US is the major hurdle to Third World Development. It now stands isolated even from its sycophantic partners. □





Automatic airliners — ready for take off?

The next generation of airliners will be largely flown by computers—with two men overseeing the operation. But that is one man less than in present planes. Could this be a trend and is it safe?

Bill Sweetman

The aerospace industry has always boasted that it is more advanced technologically than any other. Now, that very dominance of new technologies has forced it to be a pioneer in a less welcome area—of labour relations. Computers and television screens in airline cockpits cut the number of pilots needed to fly the plane, from three to two, creating a problem that is more difficult to solve than making the complex electronics work.

The focus of the industry's problem is the cockpits of three new jetliners, now being developed by Boeing in the US and the European consortium Airbus Industrie. Airlines have ordered the best part of a thousand of these new aircraft, to replace their fuel-thirsty predecessors. The first of these, Boeing's 210-seater 767 was rolled out of its hangar in August, and has started test flights. All three new aircraft will be in service by the beginning of 1983.

From the outside, the new aircraft—Boeing's 767 and 757, and the Airbus A310—look very like today's models. Beneath their aluminium skins they incorporate no revolutionary advances in aerodynamics, structures or engines. But from the pilot's seat they bring about the biggest single change in design for half a century. The airlines and the pilots agree that the new designs of cockpits represent a great advance; it is the implication of new technology for the crews which have caused them to fall out. But what is the fuss all about?

The flight deck of a modern airliner concentrates the control and authority of a highly complex system in a minuscule volume; any comparable process or form of transport would require a control room the size of a small house. The pilots have several levels of task to perform and the designer of the cockpit has to make sure that they do them all efficiently. The crew's main task is simply to fly the aeroplane without exceeding the limits of the

machine; this may seem obvious but the complexity of the other tasks tends to conceal its importance. Secondly, the crew is responsible for the relationship of the aircraft to the environment: avoiding other aircraft and the ground, planning and steering a correct course and ensuring that their actions fit in with the commands of air traffic controllers on the ground. The third task is to monitor the behaviour of the aircraft itself, making sure that the hundreds of electrical and hydraulic subsystems and components, on which the safety of the flight depends, are performing satisfactorily.

The three tasks make for a lot of work, and with new airlines, the load is increasing. The modern jet airliner is nearly 30 times larger than those of the early 1930s. Yet a DC-3 pilot of those days would find the cockpit of any airliner now in service somewhat familiar. The same basic dials and pointers are arrayed in identical layouts in front of each of the two pilots, showing height, speed, attitude and course and allowing the pilots to fly the aeroplane within limits even at night or in bad weather. The number of gauges, warning lights and switches which indicate the health of systems and which can be used to isolate a faulty system has increased dramatically—but warning lights and gauges are not new. Where something completely new has been added to the flight deck since the 1930s—such as weather radar, autopilot or inertial navigation systems—it is now to be found on the edge of the pilot's area of attention. It has not displaced other indicators from their traditional positions. The DC-3 pilot might notice one definite, qualitative change—some of the gauges and switches have been transferred to a panel to the side and rear of the cockpit, and a third crew member in a seat facing sideways monitors them. DC-3s often had just two pilots.

But put the 1930s pilot in one of the three new jets and he is faced by a row of blank TV screens and no familiar instruments. The TV screens are the obvious difference in the new cockpits, but they are merely outward signs

of a far more fundamental internal change. The old instruments were driven electrically or mechanically, responding directly to inputs from the extremities of the aircraft, or by gyroscopes driven by compressed air. Although the pictures on the TV screens used in the new cockpits can look like the old-style instruments, the similarity is as much an illusion as a Walt Disney animation. The images are generated directly by computers which interpret all the signals from the aircraft's sensors and turn them into visual form. It need hardly be said that the cheapness, small size and reliability of microprocessor technology has made these new cockpits possible.

But they do far more, far faster, than anyone imagined possible as little as five years ago. At the 1976 Farnborough air show, British Aircraft Corporation (now part of British Aerospace) demonstrated a mock-up of an "advanced flight-deck", in which black-and-white TV screens replaced some instruments; it might, as was suggested, be suitable for the generation of airliners after next. Now, the ones in the next generation have colour displays. The progress is so rapid that the new cockpits make that on the Shuttle look dated.

The TV cockpit significantly improves the performance of some basic cockpit instruments, extends the usefulness of some others and introduces some new functions. The instrument which is least changed is the "artificial horizon", that now includes the old "turn and slip" indicator, which shows the attitude of the aircraft. The colour TV version looks

Boeing's "C-cab" (far left), a model of the flight decks that will be built into later versions of its new 757 and 767 airliners. The simple, and uncluttered, layout compares strongly with Concorde's full and complex flight deck (above)



essentially the same, with a moving circle divided into blue and brown sectors to simulate the horizon.

But the new television instrument can add more information and—almost as important—can eliminate all data that are unnecessary at any given time. For example, the old mechanical instrument has small moveable metal bars linked to the radio landing-guidance system. They are needed only when the aircraft is landing, when they tell the pilot the angle and the course he needs to fly to reach the end of the runway at night or in bad weather; but through the rest of the flight the small bars continue to clutter the instrument. On the TV instrument, they can be switched off, making room for new images.

In Airbus Industrie's new cockpit, the screen which carries the artificial horizon also carries a vertical strip that shows airspeed, replacing the old clock-type meter. Normally, vertical-strip instruments are too bulky for aircraft or their scales are too small to show the other important flight functions. With a TV version, the mechanical bulkiness is not a problem. It is also possible to add details to the display which would be impossible to introduce on a conventional instrument of adequate size, such as a small arrow which changes length and direction to indicate whether, and at what rate, the aircraft is accelerating or decelerating.

More radically changed is the instrument descended from the original compass, which in a conventional cockpit still resembles the traditional compass "rose" but can accept signals from ground beacons through the aircraft's navigational system. This type of display is available on the TV screen if the crew needs it, but the new systems can provide a completely different picture containing far more information. To start with, the TV screen can cut most of the compass arc, merely showing the sector around the actual track being flown, and at a much larger scale. It adds to that a picture of a simple navigation map showing the pilot his planned course, how far he has to fly to his next turning point and what height and speed he



Boeing's first 757 takes shape. As well as using less fuel, it will benefit from computerised flight controls



The world's next three airliners: the medium range 767 (top), the short haul 757 (centre), and Europe's rival, the Airbus Industrie 310 (below)

should be making by the time he reaches it. Finally, it can add a full-colour radar picture of the surrounding weather to the map.

Radar is not new; nor are visual navigation displays of one kind or another, and, of course, the compass is the oldest navigation instrument known. What is new is that all the information that the crew used to have to assemble in their minds from three separate instruments is now combined on a single screen, on a constant scale, and—an important improvement for any map-reader—with the words all the right way up.

The aspect of the new cockpits which is arousing the greatest direct controversy, however, is the new approach to the monitoring systems—engines, fuel system, hydraulics and electrical—which are necessary for the safe operation of the aircraft. The two manufacturers have developed equipment along rather different lines. Boeing—for a long time the leading maker of airliners—started with the engines, and has gone over completely to TV for the instruments which show the pressures and temperatures within the engines. This information is so important that Boeing has to use a "belt, braces and safety-pin" approach to ensure that even if two of the TV screens fail the crew will be able to tell how well the engines are running. Half the area of one screen is permanently used for engine instru-

ments, displaying images which appear similar to the traditional mechanical type but which carry much additional information. The "safety-pin" is a tiny liquid-crystal display which shows essential engine information in digital form.

Boeing has approached the way the TV cockpit works with two principles in mind. The first is that the picture on the TV screen should change automatically only when something has gone wrong, because the change in itself is a very useful warning. The second principle is that the same information is always displayed in the same position. This makes for the most effective possible display of information about the performance of the engine; and after the primary flight and navigation data, this is probably the most important information for the crew.

The television screens in the Boeing cockpit can also display written warnings of faults in the aircraft and can be used as a check on its readiness for a flight. The computer's memory can also store the maintenance crew's list of any faults that occur in equipment.

Airbus Industrie, the European consortium which has risen in the past three years from the commercial doldrums to become second only to Boeing in the number of planes it sells, has taken a different approach. Airbus's

engine instruments are conventional electromechanical types but, like the Boeing cockpit, the Airbus flight-deck has two TV screens. Because they do not have to carry the vital engine data, which have to be displayed continuously, the TV screens can be used to their full potential for monitoring other aspects of the plane's performance.

The two television screens in the Airbus cockpit are driven by a sophisticated computer which receives inputs from sensors all over the aircraft—all the information which is usually displayed by warning lights or electro-mechanical gauges in the conventional cockpit. One of the TV screens warns the crew of any problem; the other gives further information. Both make full use of the processing power of the computer and the vast flexibility of computer-generated images, to give the crew information in a far more refined form than conventional instruments could ever achieve.

In the case of a failure, for example, the warning panel not only notifies the crew of failure but tells it what corrective actions to take and in what sequence (the crew of today's airliners need a written check-list to do this). As the crew follows the computer's list and takes the right action, the visual warnings are cancelled. But if the corrective actions have some deleterious effect on the performance of the aircraft, that fact will be noted and displayed

as a reminder to the crew. Meanwhile, the other screen, the one that gives information, displays diagrams of the affected system—something which, once again, would be found only in a written manual on a conventional flight-deck. The diagrams are animated, so that the image of the hydraulic system gives fluid levels and pressures, with symbols showing, in colour, whether a pump is switched off. Once the primary fault has been dealt with, the computer automatically displays the results the corrective action had had on other systems; if one of the three hydraulic systems is shut down, for instance, a diagram of the aircraft's control surfaces will appear, showing which of them have lost part of their power.

Both the Airbus and Boeing cockpits combine the TV screens with another new device, which sounds totally mundane but nevertheless is an important innovation—pushbuttons. The conventional cockpit has three control and display elements for every system (an oil pump or a valve, for example); an indicator that shows whether the system is switched on or off; a switch, and a fault-warning light. New solid-state switches mean that all these functions can be combined in a single pushbutton, saving a tremendous amount of panel space. Airbus has incorporated these pushbuttons into what it calls a "dark cockpit philosophy": if no lights show, the aircraft is working normally; blue lights indicate components in temporary use, green lights show where back-up machinery has been brought in to rectify a fault, while amber and red lights indicate faults that are developing.

There are two important implications of the new technology for the airline industry, and in particular for airline pilots. The manufacturers claim that the "smartness" of the new displays—the way the computers can constantly scan the instruments for signs of a fault before it achieves dangerous proportions—considerably reduces the pilot's workload. At the same time, the new push-buttons allow all the controls and instruments to be on the front face of the cockpit, instead of being hidden away on side panels. The airlines say that these new aircraft will be so much easier to fly that the third crew member, now needed to help with the complex controls and to monitor the side panels, becomes redundant. The pilots' unions—traditionally representing both technical people as well as the pilots—strongly disagree.

Airbus Industrie has tried not to become embroiled in the conflict, saying simply that its new flight-deck is equally suited to a two-man or three-man crew. In the latter case, the third man sits between, behind and slightly above the two pilots, where he can help to monitor the systems and at the same time keep a look-out in front, something the engineer in today's jets cannot do. Boeing has been more vocal, suggesting that two-man crews—common on smaller and simpler jets—are safer than three-man crews.

There are a number of arguments behind this apparent paradox. One is that pilots who have to work hard are safer because their attention is never allowed to wander. Also, as there are two "channels of communication" instead of six, there is less chance of a message going astray between two of the three members of the crew. For example, in the DC10 that crashed in Antarctica in late 1979 the third crewman kept warning that the aircraft

was too low, in poor visibility and uncertain terrain, but he was ignored by the other two. Or there was the jet in the US that collided fatally with a light aircraft with five crewmen either working or riding in the cockpit.

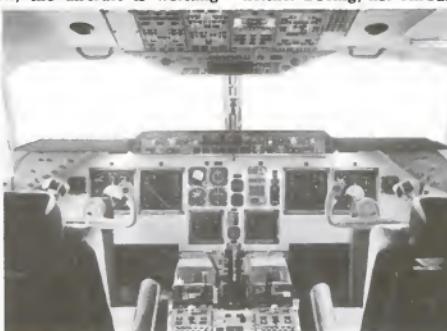
These arguments do not impress the crews. Boeing's statistics do not stand up to analysis, according to the pilots and in any event are based on a small sample of accidents. They have three basic arguments. First, although the crews concede that in some ways, the new jets may be easier to fly, they maintain that they will prevent new challenges. It will be the crew's job to ensure that the new system is working correctly and it may be necessary to reprogram the systems to accommodate a change of flight plan. Crews are already under increasing pressure to plan their flight, so as to conserve fuel, adding to their workload.

The sheer novelty of the system also worries some crews. Total failure, they say, is not the problem; but advanced electronics have a habit of generating strange failure modes in flight, and the "gremlins" that occur can disappear when the aircraft is on the ground. One example being cited is a new computer system on one airliner which erases the entire flight plan as soon as the wheels retract after take-off. The computerised cockpits are very new: neither Boeing, nor Airbus has yet flown a complete new-technology cockpit; full-scale trials being due to start later this year.

The pilots' third point is more general: it is that operations with two-man crews are less safe than operations with three crew, and is a problem that is tending to increase. Although the workload on a three-man crew, taken as an average across the flight, is relatively light, the pilots argue that this statistic is meaningless. The workload is not an average, but inevitably peaks sharply at take-off and even more dramatically on landing. With the increasing density of air traffic, a two-man crew can become seriously overloaded during a difficult night or bad-weather approach, and the crews cite accidents to two-man aircraft which support this view.

European pilot unions want the third, sideways-facing, crew member to be retained, at least on the Airbus A310, saying that in some ways the new cockpits are being designed to do too much. They suggest that an alternative layout, with three crew and a separate panel for the third man, provides a more reasonable workload, and a more logical split of responsibility, particularly in the event of a failure or failures in the automatic system, while the design could still allow the third man to help keep a lookout. Air France has already conceded the case to its pilots, and the crews of Lufthansa—the second biggest Airbus customer—are also preparing a detailed case for a similar flight-deck layout.

Ultimately, neither airline nor union can be considered the arbitrator of air safety: both are too deeply involved commercially and industrially to be regarded as unbiased. Perhaps the shape of things to come is revealed by an imminent report commissioned by the White House, which is expected to point the way to a settlement of the two-versus-three argument in the United States. Whatever the outcome of the present dispute, the shape of the airliner cockpit is about to change drastically.



The one that started it all. British Aircraft Corporation (as it was then) showed this "TV cockpit" at the Farnborough air show in 1976

M O N I T O R

Bad blood seems to cause migraine

RECENT RESULTS from London researchers have reinforced the view that the most common form of migraine is the direct result of disorders of the blood—in particular, of those once mysterious and now fashionable components, the platelets.

Physiologists have long suspected that classical migraine—whose symptoms are seeing weird lights and then suffering a blinding headache—is caused when some of the blood vessels in the brain close down.

Several substances in the body could be responsible for the close down. One is 5-hydroxytryptamine (5-HT), which occurs in blood only in the platelets.

These are small fragments of cytoplasm derived from white blood cells, whose name is now known to be immensely complex, and which cling together under various circumstances and contribute to blood clotting. Five-HT makes blood platelets clump together, and also makes blood vessels contract.

Both effects could contribute to blocking off blood vessels, and so causing migraine. Other possible culprits are adrenaline and noradrenaline—both hormones released by the body under stress—which also cause the blood vessels to contract. All three substances are made and broken down quickly during migraine attacks.

But physiologists have shied away from linking blood platelets to migraine because until very recently they have not managed to show that the headaches are associated with changes in the platelets or increase in hormones.

Edda Hanington of Wellcome Research Foundation in London, was the first to break through this deadlock with a pioneering set of experiments that showed that chemical changes in blood platelets were linked with migraine.

In particular, she showed that the level of a protein in platelets called blood beta thromboglobulin rose during attacks. This finding brought the role of blood platelets back into the foreground. Another hint came from other experiments that suggested that the level of 5-HT in platelets falls by one third during migraine attacks. And drugs that break down 5-HT have sometimes been found to be effective in preventing migraine attacks. Also, 5-HT seems to be remarkably effective in contracting the blood vessels in the brain.

With blood platelets back in the centre of the stage, Hanington and her colleagues looked at the physical properties of these cells in sufferers from migraine and normal controls. She found that migraine sufferers did have more aggregates of platelets circulating in their bloodstream. But, in direct contradiction of the earlier results, there was no significant difference in the level of 5-HT in the blood platelets between the two groups.

But the two groups of patients did differ in their reaction to adrenaline and noradrenaline, which normally stimulate release of 5-HT. For three days after an attack, sufferers released less 5-HT than usual in response to adrenaline and noradrenaline.

Hanington and colleagues at the haematology department of St Bartholomew's Hospital, conclude that 5-HT may only be a trigger in a complex chain of events that leads to migraine. And there may be other substances involved as well as the three already mentioned. In particular, adenosine di- and tri-phosphates (ADP or ATP), which are the ultimate source of energy in the body cells, also play a part in controlling the size of blood vessels in the brain, and they are always present in higher concentrations in the platelets of migraine sufferers, and are closely associated with 5-HT release from them.

THAT'S WHY IT FEELS SO BLOODY AWFUL!



Attractive people are likeable, but not memorable

PEOPLE we perceive as attractive are often the hardest to remember—we may recall the name with pleasure, but cannot put a face to it. One reason, according to three researchers in California, why we judge people to be attractive is that they have a "typical" appearance, fitting our preconceived ideas. Anything strikingly out of the ordinary is more memorable, but less welcoming.

book photographs of 120 white, male high school seniors. Each of the photographs was shown to a panel of student volunteers, who were each asked to rate the people pictured on a 5-point scale of "usualness", ranging from 1 (very usual) to 5 (very unusual).

A separate group of 31 white male students at the University of California's Los Angeles campus was then asked to



Ric Gennell

How long would you remember these faces?

Leah Light, of Pitzer College in Claremont, and Steven Hollander and Fortunée Kayra-Stuart, of the Claremont Graduate School, have been building on a body of work that goes back at least to 1907. Sir Francis Galton, a cousin of Charles Darwin and the inventor of the first intelligence test, pointed out all those years ago that a composite photograph made by superimposing the faces of several people on one print appealed to most viewers as "a very striking face, thoroughly ideal and artistic, and singularly beautiful". In repeated experiments using different photographs, Galton was struck by "how beautiful all composites are. Individual peculiarities are all irregularities, and the composite is always regular."

The new study reinforces Galton's observations. Light's team used the readily available all-American source of individual snapshots: high school year-

rate the same pictures on a 7-point scale ranging from "least good-looking" to "very good-looking". Finally, in a variety of tests involving a short glimpse of the pictures (shown as slides) and a later test of memory, Light and the others assessed how memorable each of the 120 faces was.

Their results were, as they put it, "quite straightforward" (*Personality and Social Psychology Bulletin*, vol 7, p 269). The individuals judged as most typical, or ordinary, are also the ones judged most attractive, but whose faces proved hardest to remember. The attractive faces all look alike, precisely because they lack distinguishing features. Probably none of this would have surprised Sir Francis, but it puts a new complexion on the phrase "warts and all". And does the result imply that good looking, but unmemorable, villains are more successful at eluding capture? □

M O N I T O R

Dim prospects for gamma-ray lasers

THE NEXT step on the road to shorter laser wavelengths is going to be a hard one. Physicists from the Lawrence Livermore National Laboratory in California apparently have demonstrated an X-ray laser, although it took a small nuclear bomb to do the job in experiments that remain under tight security wraps. It is not yet clear whether it is possible even in theory to build a laser that produces waves of even shorter wavelength in the gamma ray region.

"The gamma-ray laser presents as difficult a challenge as any that Man has ever undertaken," writes George C. Baldwin and Johndale C. Solem of the Los Alamos National Laboratory in New Mexico and Vitalii I. Gol'danskii of the Soviet Institute of Chemical Physics in Moscow in *Reviews of Modern Physics* (vol 53, p 687). There may be some rhetorical overkill in that statement, but the publication of an American-Soviet collaboration in the open literature may indicate no easy solutions are in sight—at least in that of security officials.

There are two basic requirements for any type of laser. First, a population inversion must be produced, in which there are more atoms in a high-energy state than in a lower-energy state. Then amplification must be produced by stimulating the higher-energy atoms to emit photons. Both requirements get harder to meet as wavelength decreases because both the energy needed to produce a population inversion and the ratio of spontaneous (non-laser) to stimulated (laser) emission increase sharply as wavelength decreases.

After the first laser—a ruby crystal emitting red light at 694 nanometres—was demonstrated in 1960, there was a flurry of ideas for lasers operating at much shorter wavelengths. Physicists soon reached the ultraviolet, but not the shorter wavelengths of X-rays (usually associated with inner-shell electronic transitions) or gamma rays (generally associated with nuclear transitions). By the late 1960s, the early ideas for build-

ing gamma-ray lasers had proved to be impossible.

A new round of theoretical proposals followed a 1972 paper by the late R. V. Khokhlov of Moscow State University, who pointed out that advances in nuclear magnetic resonance techniques opened up new ways to build gamma-ray lasers. However, Baldwin and colleagues warn that "their technological bases are less secure [than those of earlier proposals], and the precise forms of systems that might implement them are not at all obvious".

The scientists are convinced that a gamma-ray laser would have to be a two-step device. The first step would involve nuclei excited to long-lived states of

higher energy. Then those excited isomers would have to be separated from other materials and concentrated before stimulated emission and laser action could occur.

"We cannot truly say whether we are closer to the goal today than in the past, since it is not even possible to assert with certainty that the goal will ever be reached," Baldwin, Solem and Gol'danskii conclude. They then add an optimistic note: "We can say that no scientific principle has yet been shown to prohibit [gamma-ray lasers], that the scientific and technological rewards of success would be immeasurable, and that undertaking difficult technological challenges has usually been fruitful." □

Embryonic mice accept human genes

RECENT EXPERIMENTS involving the successful transfer of human genes into mice brings us one more step along the road towards gene therapy—the substitution of normal genes for their defective counterparts which cause human disease.

At a recent gathering of molecular biologists in Rome, Karl Illmensee of the University of Geneva described his latest research which involved putting human genes for insulin into mice. Illmensee was the first scientist to "clone" mice (*New Scientist*, vol 89, p 211).

Illmensee said he had clear evidence that the mice incorporated these human genes into their own chromosomes. However, it is too early to say whether these mice would have gone on to develop normally and manufacture insulin: further experiments should test this out. Scientists say that it is only a matter of time before we know enough about what happens when experimental animals take up foreign genes to attempt the same thing in humans.

Illmensee's partner in these experiments was Axel Ulrich, whose San Francisco-based genetic engineering firm, Genentech, was among the first to clone

the human insulin gene into bacteria. The two researchers extracted the gene that programmes the human cell to make insulin from human placental cells.

Using a micropipette the size of a human hair, Illmensee injected the genes into a mouse embryo which had been removed from a pregnant mouse and carefully kept alive in a petri dish.

The amount of material injected into the tiny mouse embryo only a few days old was enormous in relation to the embryo's size. Each globule of genetic material contained more than 30 000 copies of the human insulin gene, surrounded by a lot of liquid to keep the genes well nourished. The genes were stitched into a "carrier": a loop of bacterial DNA that can replicate independently in the bacterial cell (plasmid).

The next stage was to locate the human gene among the genetic material of the embryos. To do this Illmensee and Ulrich reimplanted the egg into another uterus of another mouse at about the same stage of pregnancy as the original donor mother. Towards the end of gestation they took the embryos out for autopsy. They used, as a tool, a radioactively labelled sequence of DNA precisely 310 nucleotide bases long, which would pick out the insulin gene.

Illmensee and Ulrich compared placental DNA with DNA from minced fetal cells and the radioactive probe by running the radioactively labelled samples on an electrophoretic gel. They could see that the "bands" were identical, which meant the probe had picked out identical sequences in 2 mice out of a total of 62.

Illmensee says that this shows that the carrier plasmid opened up to "free" the insulin gene (still attached to the carrier) to insinuate itself into the mouse's chromosomes. He comments that gene therapy will remain only a very fanciful dream until we can show that these experimental animals can both "express" these human genes (in this case manufacture insulin) and pass them on from one generation to the next. □

Pines take genetic revenge on oaks

SLOW-GROWING oaks have a better chance of survival in a mixed forest than the taller pines in whose shadow they live. But natural selection has taught the pines how to fight back. It seems that pines drop their needles around the oaks in such a way as to promote fires. And in a fire, pines stand a better chance of survival, because their foliage starts higher up (*Nature*, vol 293, p 643).

Bruce Williamson and Edwin Black of the University of South Florida raised fires in a Florida sandhill with a history of fires. The three main types of tree are the longleaf pine (*Pinus palustris*), turkey oak (*Quercus laevis*) and the sand live oak (*Q. geminata*).

They found that for any given height,



Forest fires—a mechanism for evolution?

the maximum temperature during a fire was greatest under longleaf pines and least in live oak groves. The researchers suggest that the needles dropped by the pine cause an aerated area under the tree, where the fire, presumably, burns fiercer, and attacks the shorter oaks. □

I. Ferro/Ardea

MONITOR

Man's ancestors: many mates or one?

WERE OUR ANCESTORS monogamous or polygynous? Unfortunately this problem cannot be answered simply by studying existing human societies. Our behaviour is sufficiently flexible to have obliterated any unequivocal clues to our prehistoric mating habits. In fact all known primate breeding systems have their human counterpart. But researchers in the UK and the US think they have found a clue.

Among primates, the weight of the testes and sexual dimorphism (the degree to which males and females differ in size and shape) vary widely between species and have long been suspected of correlating with breeding systems. For example, monogamous species are generally not dimorphic, whereas species in which the males have access to several females usually are. This is explained as a consequence of competition between males—the bigger you are, the more females you can defend, and hence the more offspring you are likely to leave behind when you die. The interpretation of the varying weight of the testes is more complicated because a major source of variation derives from interspecies differences in total body weight.

However, using some straightforward statistical techniques, Alan Harcourt, Paul Harvey and Roger Short in the UK, working with S. G. Larson in the US (*Nature*, vol 293, p 55) have been able to provide a measure of the weight of the testes relative to an "average species" of the same body size. Using this technique they have analysed data from 20 primate genera and shown that the size of the testes is invariably above average



Early man and orang-utans share family patterns

for species associated with multimale polygynous breeding systems, whereas single-male polygynous and monogamous species are generally less well endowed.

For example, male orang-utans, one of the largest primates (170kg), are over 1½ times the size of the female, yet have testes which weigh (together) only 30 grams. A more illuminating statistic perhaps is the fact that the orang-utan's erect penis is only 4 cm in length. In contrast, the lighter chimpanzee has a testes weight of approximately 120 grams

and the males and females are about the same size.

Chimps are naturally promiscuous. A group of males band together to defend a territory containing several females (on average there is usually one male per female). This cooperation between males even extends to sharing the sexual favours of females which come into oestrus. Thus, the argument goes, the low instance of physical aggression means that there is little advantage to be had in being a larger-than-average male. But each female is mated more than once, so reproductive success may depend upon the amount of sperm an individual can produce—hence the increase in the size of the testes. In contrast, the orang-utan's breeding group consists of a single male guarding several females. Females come into heat on average only once every six years and it is calculated that on average males feel unloved on 364 nights each year. There are obvious advantages therefore in paying attention to one's neighbours' mate but this can be dangerous—hence the dimorphism in size.

In the same issue of *Nature* (p 7), Bob Martin and Robert May examine the implications these findings have for humans. The relative size of man's testes is characteristic of monogamous or unimale polygynous breeding systems and the fact that humans are slightly dimorphic both in adulthood and at birth swings the evidence in favour of polygyny. May and Martin point out that their interpretation of the human data is indecisive but that other interspecies trends may help to solve the riddle. For example, the testes, erect penis and breasts appear to be much more conspicuous in humans than in other primates, but the interpretation of such observations is unclear. □

Breeding patterns can be fatal

ANTS, BEES and wasps have a strange reproductive life-style: unfertilised eggs develop into males, and fertilised ones into females. Because of this strange system, a population's sex ratio can be controlled by influencing fertilisation of a female. Indeed, nature herself seems to practise such intervention. Researchers at the University of Utah, in Salt Lake City, have found a small wasp that possesses a mutation that could spell its own extinction. It is a "daughterless" trait in which males pass on a command to produce only males. Besides being of academic interest, this mutation could be an extremely virulent weapon against insect pests.

John Werren, Sam Skinner and Eric Charnov have been studying the parasitic wasp *Nasonia vitripennis* which lays its eggs on the pupae of flies. Normally only a tenth of these eggs hatch into males. These workers started "selecting" for high-male and low-male ratios, by breeding from broods that had a particularly high (or low) percentage of males.

By the fourth generation the "high" line became dangerously male-dominated and faced extinction. The reason? All-male broods were being born; this

"daughterless" trait was passed on by "high-line" males who, when mated with any female, influence them to produce (mainly) males. The characteristic persisted in a population, even when selection stopped (*Nature*, vol 293, p 467).

How can males pass on this character, if the eggs for males are unfertilised? "Daughterless" (DL) is an extrachromosomal trait, passed on to around three-quarters of male offspring; when introduced into a (randomly breeding) population at a low level it takes over, until it is carried by 60 per cent of the wasps. DL positive sperm must therefore control the development of the egg, and force it to pass on the daughterless trait.

Investigating "daughterless" wasps may seem an ivory tower exercise, but it could be extremely important. First, study of the ways fertilisation and growth of the embryo proceed, is of significance for all of us (test-tube babies and more).

Secondly, some insect pests with the same reproductive cycle may also have a "daughterless" characteristic. If the trait could be introduced into a pest population, it could permanently reduce insect numbers: even to zero. □

M O N I T O R

The axion: ready for removal from the roll call of particles?

IT IS SCARCELY news these days when particle physicists report the discovery of a new "elementary" particle. But it is news when they decide that one of the particles they thought existed probably isn't there at all. The particle called the axion, invoked by theorists only three years ago to resolve some difficulties with their sums, now looks destined for just such a fate, although at present the jury is still out on the question of whether or not it exists.

The reason why theorists invoked the axion in 1978 was to patch up a hole in their favourite theory of the strong interaction, quantum chromodynamics (QCD). QCD describes the way in which quarks, the building blocks from which particles such as protons are made, interact with gluons, particles which carry the strong nuclear force between quarks and thereby stick the observed particles together (hence their name). This strong force is known from experiments to be invariant both in terms of mirror symmetry (or parity, P) and charge conjugation (C), and the combination of the two (CP).

In essence, this means that a mirror-image particle reaction, involving anti-particles in place of particles, proceeds in the same way, with the same probability, as the original reaction it reflects. This is known as CP symmetry.

But QCD theory does not automatically preserve CP symmetry in the way it shows up in experiments. To make the theory as symmetrical as the real world, some theorists introduced the concept of a new particle, the axion, which results from the cancellation of the unwanted CP-violating effects by absorbing them into the mathematical description of the weak interactions of the quarks.

Proof that the axion exists, however, has been hard to come by. Initial estimates of its mass gave a figure of several hundred thousand electron volts (keV), which compares with the electrons mass of 511 keV, and the theory predicts that the axion should interact observably with most of the known particles. But over

the past three years experiments using high-energy neutrino beams and the flux of particles from nuclear reactors have failed to identify reactions attributable to the axion.

Earlier this year, H. Faissner and his

the spurious surplus of "electron" scattering events.

It seems unkind for such an ingenious explanation to be shot down before it has really taken off, but that is just what has happened. The latest Grand Unified Theories (GUTs), which contain QCD within themselves, may remove the need for axions after all. In a series of papers, teams at CERN and Harvard have shown that the strong interaction CP-symmetry problem disappears of its own accord in certain classes of GUTS (D. V. Nanopoulos and colleagues, CERN Preprints TH 3105, 3116, and 3119; H. Georgi and colleagues, *Physical Review Letters*, vol. 47, p 402, and Harvard Preprint HUTP-81/A031). The specific mechanisms of the GUTS which define the masses of the quarks have the effect of reducing the mass of the axion to 10^{-6} eV and making it totally undetectable.

But the latest twist to the tale is that Nanopoulos and his colleagues have pointed out that even though the axion is now thought to be invisible, experiments should one day be able to test for its existence (CERN preprint TH 3121). The neutron can be described as a very small positive charge bound to a very small negative charge from which it is separated by a very small distance. As such, it has a dipole moment, which is just the product of the charge and the separation. This tiny moment has yet to be measured, but is known from experiment to be less than $1.6 \times 10^{-24}e$ cm, where e is the charge on the electron. In theories with no axions, this dipole moment is predicted to be close to $10^{-26}e$ cm, and should therefore be detectable with only a small improvement in experimental accuracy. But in the GUTs with axions, the neutron's dipole moment comes out much smaller, less than $10^{-30}e$ cm. A continued failure to measure this quantity as the experiments improve over the next few years would, therefore, imply that light axions may exist after all, like the fading grin on the face of the heavy axion cat. □



Axion that is here to stay

colleagues at the Swiss SIN laboratory in Zurich caused something of a stir with their claim that some unexpected results of neutrino-electron scattering experiments might be laid at the door of the axion (*Physics Letters*, vol 103B, p 234). But by a cruel twist of fate just as their results were being announced the theorists were having second thoughts about the need to invoke such heavy axions at all.

The scattering experiment involved neutrinos grazing at a small angle an electron attached to an atomic nucleus. It produced an unexpectedly high number of small angle electron scattering events, measured by a particle detector downstream in the beam, and the tentative explanation was that axions in the neutrino beam might be converted into high energy photons (gamma rays) by an interaction involving the target nucleus. The detectors used in the Swiss experiment would record the impact of a high energy photon indistinguishably from the impact of an electron, giving

Monoclonal antibodies sort breast cancer cells

NEW HOPES are being raised that the more aggressive breast tumours might be identified early with the help of monoclonal antibodies. Dr John Fabre and his colleagues at the Nuffield Department of Surgery, in Oxford's John Radcliffe Hospital have prepared monoclonal antibody to normal breast epithelial cell membrane antigens. They used it to detect whether tumour cells continued to express this antigen originally derived from the parent tissue. Some tumours did, others didn't, and this points the way to the use of monoclonals eventually for sorting tumours on the basis of a wide range of membrane characteristics which could have therapeutic applications (*The Lancet*, 1981, vol 2, p 434).

The new discovery turns the focus of cancer cell identification onto the membrane of the cell—other studies have looked at the nucleus (*New Scientist*, 6 August, p 342). The clinical importance of such tests arises from the fact that doctors cannot reliably predict the natural course of breast cancer.

In some patients the tumour can be aggressive, rapidly metastasising (spreading to other organs), and proving fatal within a few years. Other women can live for upwards of 20 years with a relatively benign tumour. With growing resistance to unnecessary surgical mutilation it is more important now than ever before to reserve aggressive therapies for the most malignant tumours.

Fabre decided to use a monoclonal

antibody capable of detecting normal breast epithelial antigens because these might be lost during differentiation of the normal cell into a cancer cell. He judged that presence or absence of such antigens on tumour cell membranes might be a sensitive indicator of the degree of differentiation and perhaps the "malignancy" of a patient's tumour.

What the test has shown is that cells from some tumours do indeed lose the antigen, and that not all breast cancer cells lose it. Because of the division that makes it possible to distinguish one (otherwise identical) tumour cell from another, Fabre hopes that this will help doctors eventually to predict the outcome of the disease and to choose optimum therapy for each tumour. □

TECHNOLOGY

Laboratories face the cost of government backing

BRITAIN'S EXPORTERS can, if they wish, have the government's seal of approval on their goods under a scheme launched last week. The Department of Industry (DoI) has set up the National Laboratory Accreditation Scheme (NATLAS) for testing laboratories. Organisations that join the scheme will be judged competent to apply British Standards and other criteria to goods (their own or other people's) for sale abroad. But testing laboratories may find that they have to join the "voluntary" scheme to avoid being left out in the cold.

The idea behind NATLAS is to enable British companies to have their goods tested before they are exported. At the moment, many importers duplicate tests on goods because they do not recognise the exporting country's results. That applies to Britain. Four years ago, exporters gathered to set up the International Laboratory Accreditation Conference and discuss the problem. Many members of the conference, now including Britain, have since set up their own accreditation schemes to put them in the league for quality control that includes, for instance, West Germany, at least for bilateral agreements. Firms in West Germany have the internationally-recognised DIN standards to meet before they can export their goods.

There are already, in fact, several laboratory accreditation schemes in Britain. Their organisers—the Ministry of Defence, the British Standards Institution, the Central Electricity Generating Board,



Britain's testing laboratories can now be government approved—at a price

Lloyds Register and the British Ready Mixed Concrete Association—have agreed to amalgamate their schemes.

NATLAS will take its inspectors from the existing accreditation schemes. Although companies who join the scheme will have to meet the costs of running it, the DoI will contribute some £500 000 during the first three years of its existence to cover initial administra-

tion costs. The scheme should help to overcome a genuine worry among test houses that their results may not enjoy international recognition, but the costs may prove very high, says Alan Berman, deputy head of the Greater London Council's Scientific Branch. Although his organisation has no responsibility for testing goods for export, Berman sees the need for his and other laboratories to join NATLAS "for results to be seen to be approved. It could be seen to be a form of protection racket."

In some respects, he says, NATLAS is out of step with current and future needs. For instance, the EEC has its own approval scheme for materials in the building industry that might conflict with some of the aims of NATLAS.

Berman is concerned about the costs of running the scheme. To keep records for annual inspection of his laboratories by NATLAS he reckons that the GLC will have to employ an extra member of staff.

Mike Dewey, director of the Fulmer Research Institute, one of Europe's largest materials testing organisations, does not foresee the need for extra staff. But he is concerned about extra indirect costs because of the time his management has to spend with NATLAS's staff in gaining initial accreditation and during annual inspections.

The main problem in applying NATLAS, says Dewey, is in its inflexible approach to test procedures. There are three main types of laboratory tests for materials, all of which Fulmer (including Yarsley Laboratories) apply.

The first is routine testing against accepted standards such as British Standards, a fairly straightforward process that fits easily into NATLAS's plans. Secondly, Fulmer might be developing a new material or component under the Ministry of Defence's own accreditation scheme. In this case, technicians might modify standard tests to save time and money, since the objects of those tests are unlikely to be finished projects. Under NATLAS, the technicians might have to put materials through much longer and more painstaking test programmes.

The third case, according to Dewey, is when the laboratories devise their own tests when no relevant standard applies. In this case, there may be some difficulty in gaining NATLAS's approval for new tests.

Under the MoD's accreditation scheme Fulmer pays virtually nothing. But now Dewey is faced with extra costs and a "daunting" application form to join NATLAS that runs to 11 pages.

Nonetheless, Dewey is a fan of the idea of NATLAS and hopes it will be mandatory. But he pleads for a more flexible approach to the scheme and calls for less bureaucracy. "If we had to list all our tests . . . [the list] would be 20 pages long, he says. "It is just not possible."

Micro firm takes a second bite

APPLÉ Computer, the American maker of microcomputers, has relaunched its Apple III personal machine. The company now boasts the first "mass storage" system incorporated into a personal computer.

The Californian company had originally introduced Apple III in the US last March, but overstretched itself. The machine did not live up to its specification and was withdrawn from sale. Apple blames the fiasco on poor quality, bought-in components, and admits that it did not properly specify the components that the machine needed.

The improved version, which costs £2695 for the basic screen and computer, has 128 Kbytes of internal memory and a built-in disc controller. It also has an operating system for organising software, which Apple calls the Sophisticated Operating System, or SOS for short. Following the current fashion for selling microcomputers mainly to businesses, Apple has also thrown in a set of programs that includes the Visicalc financial planning package and software for managing mailing lists.

The mass storage system, which holds 35 million bytes of information—the equivalent of 35 floppy discs—consists of two 8-cm magnetic discs sealed in an

airtight box the size of a briefcase. Called Profile, the storage device employs the Winchester disc technology that IBM invented: read and write heads skate over the highly-polished discs.

Apple is charging £2256 for Profile, a third of the price of some systems designed for larger machines. Wolfgang Dirk, Apple's development manager for hard discs told *New Scientist* that the company cut costs by halving the number of components in the logic that controls the discs, and by negotiating discounts on bulk purchases of components from its suppliers.

Dirk says that the magnetic disc should provide all the storage that the owner of a personal computer needs, at least for another five years. Some disc manufacturers are improving their products by introducing thin film plating techniques. Deposits of a micrometre or less greatly increase the number of tracks that can be put on a disc and allow data to be stored more compactly on those tracks.

But the optical disc, which uses lasers to read and write information onto a transparent surface, promises to replace its magnetic cousin eventually. One optical disc can store up to 200 million bytes of information. □

TECHNOLOGY

Merseyside's cleaner future is in the pipeline

THE NORTH WEST Water Authority has taken the first big step in a scheme to clean up Merseyside. The authority is building the world's longest pipeline for carrying sludge. This will end the regular dumping of sewage into one of Europe's dirtiest stretches of water.

Some 10 years of research into the hydraulics of sewage sludge—the product of treatment at a sewage works—have gone into the scheme. The pipe will carry sludge from Greater Manchester, along the Mersey, to a new sludge terminal in Liverpool's North Docks. Ships will then take the sludge to dumping grounds in Liverpool Bay.

The pipeline has presented the authority with some interesting hydraulics problems. Sludges from different works can have very different characteristics—especially when industrial wastes are mixed with domestic sewage. Some sludges are much more viscous than others. Researchers at the water authority have established the minimum speed at which sludge must travel in a pipeline to start turbulent flow. Without turbulent flow, the pipe will clog up, but pumps spaced along the pipeline could keep sludge moving.

The pipeline is a boost to Merseyside industrialists who are backing an ambitious scheme to build a barrage across the Mersey estuary at Liverpool. The

idea is to turn the estuary into a lake. The enclosed docks will be improved; dredging costs will fall; and a tidal power station will supply electricity to local industry. But the water authority says that a programme to clean up the

could work.

The Mersey barrage, 1.7 km long, would include turbine generators and sluices about 300 m long. It would be located at the mouth of the estuary. But serious environmental and engineering problems are likely to hold up the scheme for a long time. The water authority says that, if sewage in the estuary was only partially cleaned up, the barrage would pond up pollution and kill fish life.

Balfour Beatty Engineering, consultant for the scheme, has warned that conditions in the Mersey estuary do not give rise to such large tides as those in the Severn estuary. And the mouth of the Mersey is not wide enough to hold the turbines necessary to recoup the cost of the barrage. The Central Electricity Generating Board says electricity from the Mersey barrage would be far more expensive than from the proposed Severn barrage. The Mersey scheme would cost about £400 million and yield 240-400 MWe. The Severn barrage would cost £5.5 thousand million but would yield 5200 MWe.

The Merseyside Enterprise Forum argues that a tidal power station might recoup two-thirds of the cost of the barrage. The rest would be justified by benefits to shipping, the environment, recreation and other "spin-off" in the regeneration of Merseyside. □

Trolleybuses are wired up for a return

TROLLEYBUSES could soon be running again on the streets of Bradford, only nine years after the city abandoned them. West Yorkshire County Council has voted to promote a parliamentary bill that would give it the right to run trolleybuses. The bill must reach

the House of Commons by 27 November, and would eventually cost the County Council £25 000.

The new trolleybuses should be very different from the last batch to run in Bradford. The county council has investigated two vehicles. One is a conventional trolleybus that draws power from overhead wires. The other is a "dubous", a trolleybus with an auxiliary diesel engine that enables it to keep moving when the wire runs out.

Bradford still has the poles that carried wire for the old service alongside

the road. These could again carry wire for a 10-km experimental route. The county council has tested the poles to see if they can still stand the strain. They should: some of the old poles are in service with Tyne and Wear's mass transit system, the metro.

Before Bradford gets its trolleybuses back West Yorkshire will have to ask the Department of Transport for money. Earlier this year, the DoT was enthusiastic about West Yorkshire's demonstration project. But West Yorkshire relinquished its right to run trolleybuses two years ago, in another parliamentary bill—under pressure from the DoT. □

Britain's electronics firms should look to Japan

THE British electronics industry should make better efforts to sell its goods if it wants to survive, according to the National Economic Development Council. The council's electronic components working party, in a report this week, says the industry "needs to match the long-term industrial planning and preproduction investment that, for example, the Japanese undertake as a matter of course...". Allied to this, the UK industry needs to match Japan in production quality."

First impressions of the industry's performance last year indicate its good health. According to the report, output from British electronics firms increased by 12 per cent (at current prices) between 1979 and 1980—one of the biggest

increases in any area of industry. Total sales came to £1434 million, of which 50 per cent went abroad. British firms supplied rather more of the home market than in 1979; the industry's "trade gap" (imports minus exports) fell from £54 million to £46 million.

The report warns that, even though total production from the industry will probably increase, employment could well continue to fall. British electronics firms employed 128 000 in 1980, 8000 fewer than the year before. The report says: "The increase in output per head is a prerequisite for international competitiveness. However this again emphasises the need for continuing increases in output if the employment consequences are not to be very severe." □



PEYTON



Bradford's trolleybuses make a comeback

TECHNOLOGY

Commercial realities for the disabled

Aid for the disabled have become the preserve of big business. But their cost may be beyond the means of most people, reports Peter Marsh from the National AIDS for the Disabled Exhibition

Communications aids could be all talk

ELectronics is coming to the aid of the 100 000 people in Britain who have trouble speaking. The only problem is the price of the new gadgets. Social services departments are cutting back on their spending and few disabled people have enough money to pay for the devices themselves; so the burden increasingly falls on charities.

The Microwriter, a small handheld device that was developed originally for business people, is one of the most promising devices for those who cannot talk or write. The £400 gadget stores in a solid-state memory up to 8000 characters. People "write" words into the memory by touching a set of six keys. The gadget can be linked to a speech synthesiser unit to put the words in the memory in spoken form; this adaptation is especially useful for blind people as it

lets them check that the information they are putting into the memory is correct.

Microwriters are also used by people who can talk perfectly well but who cannot type in the ordinary way because of a physical disability.

As long as the person has one or two fingers with which slight pressure can be exerted, he can store words in the memory more easily than print them on a typewriter. Later, the contents of the memory are stored in a cassette and printed or displayed on a TV screen.

Microwriter Ltd has set up a special subsidiary, a registered charity, which has so far sold 80 of the devices to disabled people. Tony Eyles, a spokesman for the company, said that doctors and social services departments often discriminate against people who cannot talk

by not prescribing aids to help them.

Another device for people with speech problems is the £282 Canon communicator. About the size of a calculator, it prints out words on a narrow strip of paper according to the keys punched by the person using it.

Tools for Living of Godalming, Surrey, sells a £975 gadget called SPLINK which displays words on a TV screen. People select the words—or individual letters—from a large board that they can carry around with them.

The low-technology approach to aids for communication is represented by the products of Telemachus of Thame, Oxfordshire. The company says that it has most success selling cheap, simple devices to schools for handicapped children. More toys than anything else, these help children to recognise colourful objects or everyday items such as chocolate bars. □

Split-level kitchen—including the sink

A GERMAN company has designed a complete kitchen that is specially built to suit people in wheelchairs. Neff, which is based in Bretton, started from the premise that such people need plenty of space. The kitchen has a lot of room, specially under its working surfaces, to accommodate wheelchairs. Further, all the cupboard space can be reached from a sitting position; to get access to crockery or stores that are on shelves higher up, the cook presses buttons that brings the shelves to the right level on a rolling belt, rather like a Big Wheel at a funfair.

The kitchen sink has an inclined section on which crockery can simply slide into a washing-up bowl. The oven is at a low enough level to be easily reached. All the controls for the oven and the electrically-powered hob are in a small unit at the back of the work surface. As a final feature, the hob works only when pans are placed on top of it, reducing the risk of accidental scalding. The only bad thing about the kitchen is its price—£3100. □



The disabled can face the problems of a kitchen more easily in this set-up

Opening the door to an easier bathtime

A DESIGNER of racing boats has developed a bath that could make washing a lot easier for people who are physically disabled. For such people, bathtime often presents problems: they may have trouble climbing in, and once immersed in water, washing is likely to be difficult for them. Roy Parker of Parker Bath Developments has created what could be the perfect bath; instead of people having to move to get into it, the vessel moves to accommodate the disabled bather.

Driven by a hydraulic mechanism, the device tilts so that it is nearly upright.

The person then lifts up a "gate" that forms practically the whole of one of the vessel's sides. This lets the bather lower himself onto the bath's seat, with little more trouble than it takes to sit on an ordinary chair. Once inside, he can turn on the taps, and with a control lever adjust the position of the bath to suit his needs. Thus the bath becomes horizontal only if the person feels like lying down.

Disabled people will have to pay a lot for their bath—about £1200. So far Parker, of New Milton, Hampshire, has sold 120 of them—mainly to hospitals and nursing homes. □

A chance to stand up and be counted

ENGINEERS at British Aerospace in Stevenage have turned their hands to designing a gadget that lets a severely disabled child move around—not in a wheelchair but while standing up. Called the electric wheelstand, the device supports in an upright position a child who cannot move his or her legs but can guide the vehicle with two switches controlled by hand.

According to Peter Blower, one of the engineers on the project, giving disabled children the chance to stand up rather than spend most of their lives in a wheelchair, offers several advantages. They have better access to objects that, for a wheelchair-bound person, are out of reach. For instance, such children would be able to take things off shelves that would otherwise be too high. Furthermore, by standing up for much of the time, disabled children can avoid many medical problems—for instance pressure sores, poor limb growth and kidney ailments.

British Aerospace has made eight wheelstands which handicapped children at the Lonsdale School in Stevenage have been testing.

Further models will be built next year by Papworth Industries, which employs a large number of disabled people in the Cambridge area. Each wheelstand will probably cost about £800 to produce. □



A higher level than a wheelchair's



Zeta

Avalanches occur when snow begins to melt. But they also occur when the snow is very cold and flows more freely

Cool powders run fast

Research is showing that powders—unlike liquids—flow better when they are cool. This finding should be of particular interest to manufacturers in hot countries

Neiton Pilpel

Connoisseurs of fish and chips are familiar with the difficulties of shaking damp salt from a cellar that has suffered successive moistenings in clouds of steam. But how many people realise that a similar problem faces the modern nomad in the Sahara Desert, where the humidity is very low? His instant coffee and powdered milk will flow less freely than they do in cooler, damper Britain. However, this has nothing to do with damp; rather, it is due to the local high temperature, as my group at Chelsea College, in the University of London, has discovered.

Designers and users of automatic equipment such as food dispensers, tablet machines, bagging machines, and so on have a keen interest in the speed at which powders and granules flow from storage silos, to slide down chutes and emerge from pipes. To this end the Science and Engineering Research Council and various manufacturers of pigments, plastics, detergents, pharmaceuticals, and processed foods are sponsoring research at Chelsea College, in the hope of discovering ways to improve the flow of powders. We have been looking in to the laws that govern

the flow of powders and granules through holes—the distinction being that particles in powders are less than 100 μm in diameter ($1 \mu\text{m} = 0.00001$ metres, 20 times smaller than a grain of pollen), whereas granules are larger. Our work is showing that in particular circumstances it may be possible to make certain powders flow much faster, simply by cooling them to low temperatures. The flow also depends on the density, size and shape of the particles.

It was the inventor of the sand glass—presumably someone who was particular about the consistency of his boiled eggs—who discovered the basic law of powder flow. This is that the rate of flow of sand, unlike that of water, is practically independent of the level of sand above the hole. It depends primarily on the diameter of the hole; if you double the diameter you increase the flow rate five and a half times.

Powders block an orifice when their particles are bigger than one sixth of the orifice diameter by forming a semi-circular arch above it. They also block a hole when the particles are very small, less than 50 μm in diameter—very fine powders like mustard or precipitated chalk do not flow through holes in the conventional sense. They are too cohesive. Thus if you plot the rate of flow of a powder

Dr Neiton Pilpel is a reader in pharmaceutical technology at Chelsea College in the University of London.

through a hole of a particular size against the diameter of the particles you obtain the graphs shown in Figure 1, where the flow rate rises to a maximum for a given particle size and then falls again. This behaviour is quite different from that of liquids.

Powders are often heated during manufacturing processes. For example, to make plastic sheets you heat granules of plastic and pass them through rollers; powdered metals, on the other hand, are compressed into blocks; and the National Coal Board grinds up coal, heats it to 400°C and forms it into briquettes. In these instances, the manufacturers know that it is inadvisable to heat the materials near their melting points if they are to remain free flowing and not set to a solid mass. But until about three years ago no one appears to have considered seriously what might happen to powders if they were cooled to very low temperatures.

The main reason for this lack of interest is that it is quite difficult to measure the flow of powders at low temperatures. They tend to absorb moisture from the air, so unless they are first carefully dried and experiments are carried out in absolutely dry conditions, water or ice is deposited on the surface of the particles (like frost on a stone) and the results are unreliable. One can apply this criticism to the very limited amount of data that was pre-

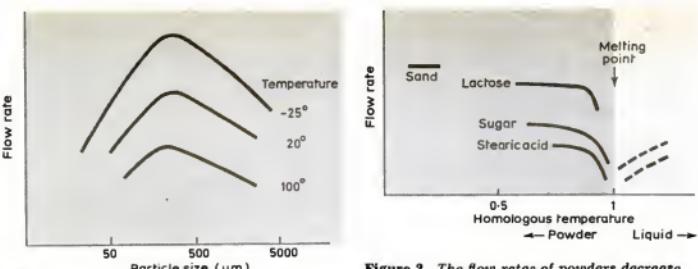


Figure 1 The flow rate of powders through a hole of particular size depends on the size of the particles and on their temperature. The hole blocks when particles are smaller than 50 μm, or larger than one-sixth the diameter of the hole. And powders flow faster when cold

viewed available from firms that use freeze-drying in their manufacture of pharmaceuticals, cosmetics, chemicals, milk powder and other foodstuffs.

At Chelsea College we have been using carefully-dried batches of powdered materials like sugar, lactose, stearic acid, oxytetracycline and griseofulvin (two pharmaceuticals); also for good measure, we used sand from a fire bucket. We grade the powders into different sizes with sieves, then pour them in turn into a thermostatically-controlled hopper, obtaining the temperature we want by blowing dry nitrogen gas through the hopper. We then measure the rates at which the powders flow from the mouth of the hopper: the results are quite dramatic.

Some of the samples, which at room temperature block the exit because of their small particle size, flow quite freely when cooled to -25°C. In nearly every case—the exception was sand—the powders flow noticeably faster as they are cooled. For example, soft brown sugar flows twice as fast at -25°C as it does at 100°C (Figure 1).

In scientific work it is often the exceptions to a rule that prove to be the most interesting. Why should sand apparently not conform to the same rule as the other powders? To answer this question consider for a moment what one means by the temperature of a powder. Stearic acid has a melting point of 70°C; sand has a melting (or softening) point in the region of 1600°C. Surely some account should be taken of this difference in attempting to compare their flow rates.

The apparently anomalous behaviour of sand becomes less surprising if you plot the flow rates of the powders not against their centigrade temperatures, but against their temperatures relative to their melting points, both measured on the Kelvin scale where absolute zero is -273°C. The "homologous" temperature of the powder is defined as its temperature in °K divided by its melting point in °K. When you then plot the flow rates against the "homologous" temperatures the resulting graphs all look like those shown in Figure 2, in which a "homologous" temperature of 1 corresponds to the melting point of the material. Clearly because of the high melting point of sand, we obtained only the very first part of the graph for sand, up to the "homologous" temperature of 0.23 which corresponds to a centigrade temperature of about 160°, the hottest we could make our hopper. If we had been able to proceed to much higher temperatures we would probably have found that sand behaved in the same way as the other powders.

At their melting points most powders turn into liquids though some, like lactose, merely soften and decompose. At still higher temperatures the flow rates of the molten



Flour may flow less freely in a hot kitchen, but sand in timers will be barely affected



World Medicine

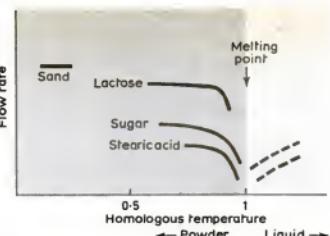


Figure 2 The flow rates of powders decrease as they are heated towards their melting points, where the homologous temperature—the ratio of the temperature to the melting point—is 1. Above the melting point the powder turns into a liquid, and then flows faster as it is heated further (dashed lines)

liquids increase as their viscosities increase. Motorists know that engine oil flows faster when it is hot than cold; other liquids behave similarly and this is indicated by the broken curves on Figure 2. Once again there is a fundamental difference between the flow properties of the powders and of their corresponding liquids.

Figure 2 also shows that the flow curves of many powders begin to bend steeply downwards not, as might be expected, at their melting points where the "homologous" temperature is unity, but at temperatures substantially lower. Thus griseofulvin begins to flow less freely at 160° even though its melting point is 220°. Why should this be?

Half a century ago, Professors F. P. Bowden and D. Tabor in Cambridge showed that particles in a powder touch only at a very few points on their surfaces. When the particles start to flow, high pressures develop at these points and the friction between them generates heat. The total amount of heat produced is small but it is localised and it can cause minute patches on the surfaces of the particles to deform plastically and even to melt. The patches are only a few nanometres (thousandths of a μm) thick but our results suggest that, like patches of moisture, they make the surfaces of the particles sticky and inhibit the flow of the powders. It seems that this mechanism can operate even if the powder is at temperatures 50–100°C below its conventional melting point. This explains why the curves in Figure 2 bend downwards, as it were, prematurely.

An explanation for avalanches

These findings may provide an explanation for something that has been puzzling workers at the Swiss Federal Institute for Snow and Avalanche Research for many years. They discovered that snow has a tendency to avalanche when its temperature is close to 0°C—the weight of the upper layers of snow causes the lower layers to melt and the whole mass then slides on a lubricating layer of water. But they also know that snow avalanches when it is very cold, below -20°C. The melting point of snow is 0°C so a temperature of -20°C corresponds to an "homologous" temperature of 0.9, that is 253/273. This is precisely when, moving left on Figure 2 to lower temperatures, the flow rates are rising and when, therefore, one might expect granules of snow to begin to flow freely.

There is an obvious way in which one might make practical use of our findings on the effects of temperature on the flow of powders. In hot countries particularly—Nigeria, India, Brazil, Malaysia, the southern United States, and indeed even in Britain and Europe during hot summers—manufacturers often have difficulties in handling and processing powders of relatively low melting points. Examples of these are soaps, detergents, gums, waxes, resins, many organic chemicals, low melting plastics, formulated foodstuffs and pharmaceuticals containing mixtures of ingredients. Hoppers and pipes become blocked, the powders flow spasmodically or not at all. As a result half-filled cartons or capsules have to be discarded and apologies sent to dissatisfied customers.

Some of these difficulties might be avoided by cooling the powders. Clearly it would be necessary to take precautions to prevent the cold powders from absorbing moisture from the atmosphere; otherwise they would become damp and again cease to flow. We need to do further work to investigate the feasibility and economics of the method if it is to be employed industrially.

In the meantime connoisseurs who prefer to use sand glasses rather than more sophisticated electronic devices for ensuring the consistency of their boiled eggs may rest assured. Whatever the temperature in their kitchen it is unlikely to have any significant effect on the flow rate of the sand through their timers.

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R E V I E W

Nuclear war: the facts laid bare

Hiroshima and Nagasaki: the physical, medical and social effects of the atomic bombings

by the Committee for the Compilation of Materials on Damage Caused by the Atomic Bombs, Hutchinson, pp 752, £20

The two atom bombs which destroyed Hiroshima and Nagasaki brought the Second World War to an end. Since then some 1300 tests of nuclear weapons have been carried out, but never again used in combat, although on several occasions we came perilously close to that. However, during these 36 years there was a spiralling nuclear arms race, which resulted in the introduction of weapons thousands of times more powerful than those used in Japan, and in the amassing of stockpiles with an explosive power greater than a million Hiroshimas. Numerous studies have been made of the effects of a nuclear war, the scale of destruction, the number of casualties, the effectiveness of civil defence measures. Basically, all such assessments have to be derived from the experience of Hiroshima and Nagasaki, even though the aftermaths of two "small" bombs hardly bear any relation to the economic, psychological and societal upheavals that would follow an all-out nuclear war with modern weapons.

The experience of the Japanese cities is of importance also in the non-military field. In a world in which ionising radiations play an ever-increasing role, it is necessary to know the hazard from small doses of radiation. Such knowledge is best derived from human data, from the exposure of a large population to a range of doses. The survivors of the Japanese bombs are such a population; it is claimed that they present the best material for the assessment of radiation hazards.

For both these reasons the consequences of Hiroshima and Nagasaki have been the subject of the most painstaking and detailed investigations. The book under review contains about 900 entries! But the saga is far from ended.

Hiroshima and Nagasaki is as complete as possible an account of the state of knowledge of the many aspects and consequences of the bombs. It took three editors four years to prepare with the assistance of 34 Japanese specialists in physics, medicine, social sciences and the humanities. Essentially it is a compilation of most that has been published on the subject up to 1979 (a high proportion of it

was in Japanese only). The motive for this monumental work is never left in doubt. "We have been doing all in our power to convey the A-bomb realities to people everywhere, simply because we fear for the future of all mankind, including ourselves," say the Mayors of Hiroshima and Nagasaki, the instigators of the book. But this does not detract from its intrinsic value, the detailed descriptions in the text, the numerous tables, the many figures and photographs which illustrate the findings. There is a wealth of material as well as a source for further analysis and more study. Indeed, many of the chapters conclude that much is still not understood, or that adequate data are still not available.

This applies in particular to the most basic of all the effects of the bombs: the number of casualties. There is no doubt that the Hiroshima bomb (equivalent to 12.5 thousand tonnes of TNT) brought a much larger toll of deaths and injuries than the more powerful (22 thousand tonnes) Nagasaki bomb—due to the latter missing the centre of the city and the more hilly

terrain—but there is a very large uncertainty about the absolute numbers. The official estimate of the number of deaths in Hiroshima was 68 000, with unofficial estimates ranging from 33 000 to 133 000. But a very detailed analysis of the movements of the population—civilian, military, foreign labour—before and after the bomb, has led the editors of the book to the conclusion that the number of deaths up to 1950 was about 200 000 in Hiroshima alone. To a considerable extent, this increase by a factor of three over previous estimates is probably attributable to a very high rate of mortality during the months after the bombing.

Since the book was written,

the use of the data from the survivors to calculate the carcinogenic effect of radiation has come into doubt for yet another reason: a reassessment of the dosimetry (measurement of radiation dose) has led to a substantial change. With the revised dosimetry it has become necessary to re-evaluate the dose received by each of the survivors, a huge task, but considered important enough by US authorities to

provide financial backing for it.

But these issues, however significant, must not obscure the main verdict of the book, that the damage caused by nuclear weapons is more serious than was thought before, and that the consequences of even rudimentary—by present standards—nuclear bombs are such that nuclear war is not acceptable under any circumstances. In the light of the facts presented one can only describe as cynical the attempts by some authorities in this country to use the happenings in Hiroshima and Nagasaki to bolster civil defence measures by telling us how much was allegedly achieved there by a small resolute team of doctors, nurses and administrators, with little outside help. Actually the help had to come from outside, because hardly anything was left. The casualties in Hiroshima included 90 per cent of physicians, 86 per cent of dentists, 80 per cent of pharmacists and 93 per cent of nurses. The pitiful medical help was provided from outside, from teams of doctors from medical associations, and from army medical units, in other cities. From where would such help come if Britain were attacked not with two bombs but with hundreds of them, with an explosive power 5000 to 50 000 times greater than that of the two Japanese bombs combined?

It is quite beyond our capability to imagine the scale of devastation of an all-out nuclear war, not only in human carnage or economic wastage, but in the break-down of the whole fabric of society. As the chapter "A Society Laid Waste" shows, this happened even after the "small" bombs used in Japan. "An atomic bomb's massive destruction and indiscriminate slaughter involves the sweeping breakdown of all order and existence—in a word, the collapse of society itself." This conclusion of the Japanese Committee makes invalid any rationale of a nuclear war, and the message of the book rings out clearly and loudly: no more Hiroshimas and Nagasakis, no more nuclear war.

Joseph Rotblat



Looking back on Nagasaki. The effects of that small bomb would be multiplied thousands of times in a modern nuclear war

Professor Joseph Rotblat is Emeritus Professor of Physics at St. Bartholomew's Hospital, and a member of several international organisations for world peace.

R E V I E W E W

In quest of telescopes

by Martin Cohen

Sky Publishing*, pp 131,

\$11.95

Martin Cohen is a young British infrared astronomer, now based in the US, who has worked with some of the world's biggest telescopes. His experiences provide the basis for this book, which takes the form of his "astronomical autobiography" up to 1979. "It tells you what it is to lead the life of a professional astronomer," he says. "I know that during my late teens I would have liked to find and read such a book, but none was available." The blurb on the dust jacket tells us that "... the down-to-earth appraisal Cohen gives astronomy as a profession ... is especially valuable to the youngster contemplating entering the field".

Up to a point, this is true—Cohen's earlier chapters, from the initial stirrings of his interest (at the age of four), through the school astronomical society and up to Cambridge (to read mathematics) are certainly inspiring stuff. But there is no help after this for the youngster suffering second-year undergraduate blues, or who is going through the usual research student's

* 49 Bay State Road, Cambridge, Massachusetts 02238, USA.

Space science comes of age
edited by Paul V. Hantle and

Von del Chamberlain
Jane's, pp 194, £10

Subtitled "Perspectives in the history of the space sciences", this is an odd collection of essays written mainly by pioneers in space science: "odd" because some of the items are excellent vintage tales of the early days in space, whereas others are rather tedious. Among the presentations I really enjoyed is one by Richard Hallion on the development of American launch vehicles, and another by Lyman Spitzer about the growth of his field of ultraviolet astronomy — possible only above Earth's obscuring atmosphere. Both are fascinating tales as they start in the days before Sputnik, when space science itself was an oddity, not a matter of fact, and one is reminded of the technical difficulties the pioneers faced.



Inram Pan

love-hate relationship with a supervisor, a computer or a thesis. Cohen is a high-flyer, but some of his contemporaries were not: I wish he could have mentioned some of their problems to reassure some of the less-confident students.

Although I applaud Cohen's motives for writing his account, the autobiographical approach jars a little when you realise he couldn't have been more than 31 when he wrote it. It occasionally hits you as sounding presumptuous. And the overall balance would have been better—although the book would have doubled in length—had the perspective been purely autobiographical.

Spitzer recounts attempts to obtain stellar spectra using sounding rockets with an attitude control system to point the rocket accurately. On the first flight winds blew the rocket off course and further complications ensued; on the second flight an electronic fault stopped the attitude control system working, and on the third "successful" flight, the parachute carrying the instruments back to Earth failed to open so the package crashed into the desert and the film cassette lay open in the sun for an hour or so before scientists managed to reach it.

Hallion, on the other hand, explains how launchers for spacecraft were developed from a variety of military rockets—missiles—with the US Army, Navy and Air Force making a variety of contributions. The Army's work, starting from V-2s captured from the Germans, led ultimately to the development of the Saturn rocket that took men to the Moon.

and not, as we find in the later chapters, selective. Just as we are getting to know the author, he jets across to the US in search of post-doctoral fellowships: his story then becomes a chain of close encounters with telescopes. In one sense, this is the meat of the book. But without an insight into Cohen the human being—his lifestyle, his friends, his many other interests—the reader can come away with the mistaken impression that astronomers are so devoted to their subject that they spend no time whatever thinking about anything else (except observatory food, perhaps).

Leaving aside these criti-

One of those men should have been Eugene Shoemaker—at least, that was his dream as far back as the late 1940s, as he explains in his contribution on lunar geology. Instead Shoemaker watched another member of his team walk on the Moon in 1972, with mixed feelings as he recalls in his delightfully personal account. Another fascinating piece of history is recorded in the transcript of James Van Allen's first presentation of his team's discovery of intense radiation trapped by Earth's magnetic field in the now-famous Van Allen belts.

On balance, this is a lively reference book; more intriguing than a straight historical account but patchy in its presentation, which is not helped by some ugly typesetting. And in this day and age the lack of colour pictures may make the book less appealing to the casual reader than it deserves to be.

Christine Sutton

cisms, this is the only book I have read that takes contemporary astronomical research, from funding to filter-wheel spectroscopy, and tells it like it is. There are at-the-telescope accounts of days and nights spent at most of the main American observatories which will be an inspiration to star-struck youngsters (and amateur astronomers) and a useful guide to students. The infrared jargon of Cohen's own research field is generally well-explained and his accounts of the great observatories, their settings and their natural phenomena are vivid.

This is an important book, and I hope it will become a guiding light for the up-and-coming generation of young astronomers. I will be recommending it strongly to the youngsters who come on our annual "Careers in Astronomy" course at Greenwich, prefaced by the warning "Reading this book could damage your health unless you realise that astronomers are human, too".

Heather Couper

Heather Couper is a lecturer at the Greenwich Planetarium, National Maritime Museum, London.

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R E V I E W W

The new racism

by Martin Barker

Junction Books, pp 208, £12.50
pb £4.95

So far as popular action is concerned, the Anti Nazi League has made the links which bind England's National Front to Adolf Hitler's Nazis very plain. Three years ago, in a book called simply *Fascists* (Harcourt Brace Jovanovich), Michael Billig traced in depth the conceptual and intellectual (if these aren't too ambitious terms) debts the NF owes to Nazism. In *The New Racism* (subtitled "Conservatives and the Ideology of the Tribe") the philosopher Martin Barker does not attempt to belittle the Nazi connection. But he explains the much more common and insidious, taken-for-granted racism which permeates contemporary England, a racism which is one of the less savoury parts of the English working class tradition and is a reiterated theme of the "ordinary" Tories whose voice Thatcherism represents.

Barker begins by showing how by the 1970s English racism—with its talk of the "natural" fears of the indigenous white population, of "swamping", of "fair" immigration and nationality rules—had become normalised. He shows how the roots of this racism lie in particular aspects



of English political tradition, but he is centrally concerned to show how the new racism draws both on an old philosophical theme stretching back to the 17th century and David Hume, and on a new "biologism".

In a series of incisive chapters, he explains the links that bind both 1960s ethology (the pop-science of Robert Ardrey, Konrad Lorenz and Desmond Morris) and the sociobiology of the 1970s (typified by Richard Dawkins and E. O. Wilson) with contemporary racism and its interlocked New Right ideology. He shows that, whatever the protestations of its protagonists to be above "mere human politics", as

Richard Dawkins put it not so long ago in a letter to Britain's other scientific weekly, sociobiology contains embedded within its premises values which it then proceeds to derive, tautologically, from its human and non-human evidence. Sociobiological theories are inevitably circular, and hence vacuous; they become what Barker calls "ideological science".

He is not concerned merely to criticise the evidence offered by the sociobiologists, or to oppose the theories just because they are racist, but to integrate simultaneously a philosophical, logical and political attack upon their premises. Further, he does so

Otto Warburg

by Hans Krebs

Oxford UP, pp 141, £10

Hans Krebs pointed out several years ago that Nobel prizewinners form a sort of intellectual dynasty in which they can frequently be related as mentor and pupil throughout several branching generations. Here his point becomes self-fulfilling when he, perhaps the best known of all biochemists, takes up the pen to write of his teacher Warburg, a dozen of an earlier generation. Warburg died in 1970 at the age of 87 and this book originates from obituary notices that Krebs was invited to provide. The scientific achievements of Warburg are described in 50 pages, his personality in 30 and the rest of the work consists of notes, bibliography, index and photographs.

When Warburg started his



career in biochemistry in 1918, the representation of that subject in Germany was, according to Albert Einstein, "rather mediocre", no doubt by comparison with the quality of German physicists. Warburg's work alone is sufficient to change that assessment in later years. His contributions are both to tech-

niques and to problems. He greatly improved manometer design and produced an instrument which was standard for decades in the study of gas analysis in processes such as cell respiration, photosynthesis and alcoholic fermentation. He pioneered the application of spectrophotometry in biochemistry and hence laid the foundation for a vast amount of our understanding of the mechanism of biological reactions in molecular terms.

Finally Warburg developed the tissue slice techniques for investigating the chemistry in whole tissue in a manner more relevant to living bodies. The subjects Warburg illuminated were of central importance—respiration, fermentation, the role of enzymes and heavy metals, the pentosephosphate cycle and photo-synthesis.

However, Warburg was no ivory tower inhabitant. His

from the standpoint of one who describes himself as a committed Darwinist—not tarring with the Creationist brush here, nor even a tinge of fashionable neo-Lamarckianism. The point, for Barker, is that in contradiction to the sociobiologists, the essence of human beings' biological nature is to transcend that nature through the creative potential of the human brain, and above all through the socialised nature of human production and reproduction. It is because sociobiology and sociobiologists cannot grasp this point that they, like David Hume, cannot but be racist for Martin Barker, and why he sees sociobiology to be so deeply "in tune" with New Right thinking.

Readers accustomed to the fragmentation of knowledge, which is another typical aspect of contemporary society, and who want to know in advance whether the book they are reading is about contemporary politics, classical philosophy, evolutionary theory or whatever, should beware. This book transcends such narrow disciplinary boundaries, without ever losing itself in the technicalities of the argument or becoming superficial. A model of clear thinking and writing, it deserves to be widely read.

Steven Rose

Steven Rose is professor of biology at the Open University.

great ambition was to solve the problem of cancer. He thought he had the "primary cause" when he discovered fermentation replacing respiration in tumour cells. Krebs is perhaps a little severe on Warburg's neglect of fundamental biochemical aspects of control of cell growth and what he terms Warburg's failure of judgment.

The section on Warburg's personality is of great interest. He emerges as autocratic, tetchy, aloof. The only goodness Krebs finally ascribes is that of Faust. The account of how Warburg's laboratory was run is fascinating—absolute power to Warburg. Contemporary experience has shown this is not essential for good science. Warburg's science however, is worth remembering.

Andrew Miller

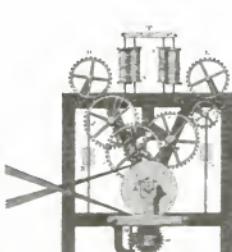
Dr Andrew Miller is in the Laboratory of Molecular Biology at Oxford University.

R E V I E W W

**Transatlantic
industrial revolution**
by David J. Jeremy
*Basil Blackwell, pp 384, £16**

It is surprising, in the light of the economic success of the Japanese in our own day, that so little attention is paid, either by industrialists or historians, to the manner in which industrial know-how passes across national boundaries. This book shows that the speed with which new ideas travel depends not only on particular individuals, but on government policies, social attitudes and the availability of skilled labour and raw materials. The author takes as his example the period from 1790 to the 1830s, when the textile industries in the US were enjoying unprecedented growth, and asks: What factors promoted the spread of technology from Great Britain and reshaped it so that it fitted American needs?

At first, American entrepreneurs, anxious to develop



English throstle frame, 1812

a home-based industry, relied upon the illegal importation of machinery from Britain, but it soon became clear that machinery on its own was useless. One Spinning Mule lay disassembled for four years at Philadelphia because no one knew how to put it together. Skilled men were required who knew how to build, run and repair the machinery and how to organise factory production.

Not all attempts to use immigrants were successful. Some men were secretive and refused to pass on their knowledge to an indigenous work-

force. Some took to drink. Others were rogues who decamped with company machinery and set up elsewhere. As one manufacturer said of his immigrant workforce: "I repeat Sir, unless God should send us saints for workmen and angels to conduct them, there is the greatest reason to fear for the success of the plan". Some were successful, like the seven Schofield brothers from the West Riding who, sensing the impending displacement of wool by cotton in Yorkshire, emigrated to Charlestown in Massachusetts in 1793. Within four months of arrival they were in production; a remarkable achievement considering that they brought no tools or machinery with them and had little capital behind them. Local business, impressed by their frugality and competence, funded them in a slow but steady expansion.

When the new technology arrived in the US, it was modified to suit circumstances. For instance, better quality fibres allowed power loom weaving with machines that

used more force on the fibre than was possible in Britain. Hence cruder mechanisms, which could be put into production quickly, could be used. The market favoured coarse but durable fabrics and made long runs of standardised goods possible. In Britain labour was cheap, whereas in the US it was not and there was therefore an incentive to keep down overheads by introducing labour-saving improvements. Moreover, because of the plentiful supply of machine makers — mainly emigrant Scots and Englishmen — the cost of capital equipment was constantly falling. Consequently innovation proceeded at such a rate that before long ideas were beginning to flow back to Britain.

This book has much to say about the flow of ideas that is relevant to the 20th century, and is well illustrated and annotated. In some places it betrays its derivation from a PhD thesis, but this is a small price to pay for the depth of treatment that it gives to its subject matter.

Antony Anderson

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**The Chaco degraded
the route to Chagas disease**

A



B



C



D



E



F

Economic assault on Chagas disease

The parasites that cause the fatal Chagas disease infect 10 million people in South America. Research concentrates on producing drugs, vaccines, and insecticides. Is land-management a better alternative?

**E. H. Bucher
C. J. Schofield**

Over a huge area of South America the people are decimated by a chronic, incurable, and fatal parasitic infection known as Chagas disease. Research concentrates on producing drugs and vaccines to eliminate the parasite, or on insecticides to eliminate the bugs that transmit it. Yet the roots of the disease are not simply biological. They spring, in large part, from poverty; the fact that many people are obliged to live in scattered, crumbling huts in constant contact with the insect vectors that carry the disease, and far from the means of controlling it. The answer to Chagas disease must surely be not simply to attack the pathogen and its vectors but to raise living standards in areas where cattle and forestry must be the main source of income, but in which poor management and over-exploitation have impoverished the soil and interrupted natural cycles of production. Such an ambition, in a time of world recession, may seem unrealistic; yet in one province of Argentina, a scheme master-minded by Carlos Saravia Toledo, is now showing that good land management is possible, and can produce the necessary improvements.

From north-eastern Brazil to central-north Argentina runs a corridor of open vegetation. Two dry woodland areas, the Caatinga in north-eastern Brazil and the Chaco in northern Argentina, are isolated by a savanna corridor known as Cerrado, which is sandwiched between the Coastal and Amazonian rain forests (Figure 2). The Chaco-Cerrado-Caatinga system is characterised not just by biogeographical features, but also by certain patterns of land use, rural poverty, and a high incidence of Chagas disease.

Chagas disease is caused by a protozoan, *Trypanosoma cruzi*, a close relative of the trypanosomes that in Africa cause sleeping sickness. In the initial stage of Chagas disease—the acute phase—the parasites invade the tissues, particularly the

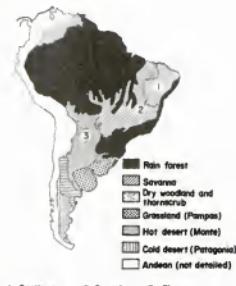


Figure 2 A corridor of dry vegetation goes from the Caatinga in NE Brazil (1) through the Cerrado of central Brazil (2) to the Chaco of northern Argentina (3). To the south the Chaco merges with hot desert and the pampas grasslands. (In this map the Andes are occluded)

Figure 1—The Chaco degraded (opposite). The original vegetation of the Chaco is a mosaic of woodland and grassland (A). Grassland is protected from encroaching woodland by periodic fires (B) which maintain a stable mosaic. Although this ecosystem can support a reasonable number of cattle, overgrazing removes grass, dry matter and soil erosion can result (C). Reduction of fires triggers rapid encroachment by woody vegetation (D). Timbering eliminates large trees, leaving unproductive shrubs and old and diseased trees (E). Reduced grassland makes the area unsuitable for cattle and many peasants turn to goats. These destroy young trees, as well as grasses, leading to an impoverished landscape dominated by a dense and unproductive shrubland where only scattered huts surrounded by a ring of barren land remain (F).

heart, and can be found in the blood. The victim becomes feverish although the symptoms are not always obviously those of Chagas disease and may be confused, for example, with malaria. Though some people die in the acute phase of the infection, most survive.

The disease then passes into the chronic phase. Few parasites remain in the blood, but many continue to survive in the vital organs. The victim may be free from symptoms for many years until severe damage becomes apparent, often in the large bowel or the heart: and the autonomic nerves, which control or at least influence the body's involuntary vital movements such as the beating of the heart, may also be destroyed (see box A). Death often results from cardiac insufficiency, the weakened heart simply failing to pump enough blood, particularly after unaccustomed exercise.

The blood-sucking "barbers"

The trypanosomes that cause African sleeping sickness are transmitted by tsetse flies, from the order of insects known as Diptera. The trypanosomes that cause Chagas disease in South America are typically transmitted in the faeces of blood-sucking bugs, of the insect order Hemiptera. Probably all 100 known species of the hemipteran family Triatominae are able to transmit Chagas disease, but only those species that come into close contact with man, by colonising his houses and outhouses, are important vectors. These include species of *Triatoma*, *Panstrongylus*, and *Rhodnius* (see box B); but in Brazil they are known as "barbeiro" (which literally means "barber"), since the bugs often bite the face of a sleeping person and in Argentina as "vinchuca" (meaning "insect-which-falls", as the bug often drops from the roof on to beds in order to feed). In some forms of the disease, the parasites live in "reservoir" hosts, such as opossums and armadilloes. In others, the parasite follows a purely "domestic" cycle, transmitted from person to person by bugs living in and around the houses.

As yet, Chagas disease is incurable; and it is widespread. Data published by the health services of affected countries suggest that more than 10 per cent of the population of Argentina and Brazil may be infected. As those infected may be the breadwinners of a family, the number of people in some way affected by the disease must be considerably higher. In all, between 35 and 50 million people are thought to be at risk to the disease.

Attempts to control Chagas disease rely almost entirely on high-dose spraying of insecticides over the cracked walls of houses and outhouses in which the vinchuca lives. But this approach, although not without some success in certain areas, is beset with problems. In particular the insecticides become inactive on the alkaline porous mud of the walls. Paradoxically, because of concern about pollution and residues on agricultural crops, manufacturers of insecticides now tend to emphasise that their formulations have only short persistence in the environment. Yet for control of Chagas disease, insecticides that remain active on house walls for a long time—that is, have high residual activity—would be preferred.

Many of the problems of control are not technical,

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however. As several outstanding research workers in Argentina and Brazil have emphasised, the logistic, economic and administrative problems of treating large numbers of houses regularly—houses that are widely dispersed in areas of difficult access—all contribute to the lack of success in control.

Carlos Chagas, who in 1909 first described the disease, recognised the association between Chagas disease and rural poverty. This association, of poor living conditions involving cracked walls and roofs which provide refuge for the vinchucas, is not disputed, but it deserves a deeper analysis. It is worth examining how rural poverty came about, and more particularly how it is maintained. To do this we examine the ecological features of the Argentine Chaco, which has the highest incidence of Chagas disease in the country, and the links between natural resource and the prevailing patterns of land use.

The vast quaternary plain known as the Gran Chaco is a natural region of about 1 000 000 sq. km extending over parts of Bolivia, Paraguay, Brazil and Argentina. It is a huge "outwash plain"—built up of sediments derived mainly from the eastern Andes. Because of the arid climate, primary minerals and soluble salts are abundant. The heavy textured soils make the area susceptible to flooding during the wet season, and low areas with poor drainage have extensive salt pans, particularly in the provinces of Cordoba and Santiago del Estero; the salt excludes all vegetation in some places. Population density is low, usually averaging fewer than five people per sq. km. The vegetation of the Chaco is a mosaic of forest, woodlands, savannas and grasslands. But although it is so heterogeneous both in appearance and in ecology, it has many plants and animals in common that characterise it as a biogeographic unit.

In the eastern Chaco, towards the banks of the Paraná river, cotton has been a major industry. But since the boom years of the 1920s and 1930s there has been an increasing struggle to maintain production in the face of soil exhaustion and poor husbandry. Bad harvests and floods in the 1960s put paid to many small cotton plantations, although the area still provides more than half of Argentina's cotton.

In the western Chaco, which has seen some of the highest temperatures ever recorded in South America, annual rainfall rarely exceeds 500 mm and is concentrated in a five month period. This hardly permits agriculture without irrigation. The main industries have therefore concentrated around cattle and exploitation of the forests. Several valuable hardwood species of the Chaco provide good material for construction, railway sleepers, and furniture. At one time the hard "quebracho" or axe-breaker (*Schinopsis balansae*) was a major source of high quality tannin, since superseded by tannin from mimosa and synthetic products. Unfortunately, the natural forests and grasses of the western Chaco have been mismanaged. The environment has deteriorated and, as shown in Figure 1, the pattern of land-use has changed.

Grasslands are reborn through fire

The primitive landscape of the region, before the European immigrants arrived, was a parkland with patches of hardwood intermingled with grasslands (A, in Figure 1). This mosaic of vegetation was kept stable by occasional floods of low-lying areas, but more importantly through periodic fires produced by lightning or by the Indians, who were skilled in managing fire. Fires were fuelled by a considerable biomass of grass accumulated during the preceding wet season. Very few woody plants are adapted to resist repeated exposure to fire, and even fewer are favoured by it. But grasses germinate, grow, and reproduce rapidly; they respond positively to fire. Thus the succession of floods and fires prevented woodlands from

A. The evils of Chagas disease



Though the parasites that cause Chagas disease are transmitted by blood-sucking bugs, they are not injected directly into the body as the insect feeds—in the way that malaria parasites are injected by most quinine. Instead, the parasite is carried in the bug's faeces, from which it gains entry either via the wound caused by the insect's feeding—commonly on the face, (top left); or, frequently, via the eye—producing the characteristic "Romana's sign" (top right).

The parasite may live for many years in the tissue of vital organs, such as the heart or the gut. Above right is the apex of the left ventricle from the heart of a Chagas victim. In a healthy heart, the space beneath the white line would be solid muscle, like the sides. Megacolon—gross enlargements of the bowel, above left—is another common consequence of Chagas disease.

encroaching on the grassland. Such "pulse equilibrium" is common to many other semi-arid savannas throughout the world.

Grasslands, maintained by seasonal fluctuation in water level and periodic fires, can support a certain number of cattle. But after Europeans came, the fires were fewer and less intense because of the withdrawal of the Indians and overgrazing by introduced cattle, which eliminated the



Figure 3 In its primeval state the Chaco consisted of forest and grassland, kept stable by fire and flood

B. The big six: principal vectors of Chagas disease



necessary fuel. In addition, over-grazing often led to erosion which altered the pattern of drainage and changed the nature of the seasonal floods. Without protection by either fire or flood, the patches of grassland were rapidly invaded by woody vegetation, usually to the point of complete elimination.

As the grasslands of the western Chaco were eliminated so too was the capacity to carry cattle. Many impoverished farmers turned instead to goats which, unlike cattle, are browsers and will also eat young trees and shrubs (F, in Figure 1). The human population in the region decreased, and also the standard of living of those who remained; descendants of the first settlers.

The felling of large trees for timber, tannin and charcoal disrupted the ecology even further. Felling was favoured by a wide network of railways and was particularly intense during the Second World War because of the shortage of petroleum. Argentine steam locomotives were fuelled almost exclusively by quebracho wood. The intensive exploitation (and devastation) of the Chaco's natural

resources brought about an ephemeral period of prosperity along the western frontier of forest felling. Many of the descendants of earlier settlers were employed as "hacheros" (axe-men) but their jobs disappeared with the last of the hardwood quebrachos. They were then forced to migrate to the big cities though some remained, living in extremely poor conditions in small isolated huts and raising goats and producing charcoal on a very primitive basis. Overgrazing by cattle and goats inhibited the return of the quebrachos by killing the young seedlings, reducing the forest to scrub.

This sequence of events changed a relatively productive region to areas in which the productive biological machinery was severely impaired or even completely destroyed. The combined impact of cattle, goats and timbering led to an impoverished socio-ecological system which is reflected by the present appearance, with immense areas covered by dense unproductive thornscrub, interrupted here and there by stretches of barren land around human settlements in which only a few old trees unsuitable for timber have been left (Figures 3 to 5).

The typical mud brick hut of poor rural areas, with its associated goat corral provides an ideal habitat for one species of vinchuca (*Triatomella infestans*) that carries Chagas disease and is virtually never found in other habitats. As impoverishment progressed the herds of cattle and goats rapidly declined, and people became increasingly nomadic as they went in search of temporary employment, usually as harvesters, in other areas. Migration of people from impoverished rural zones carries many social problems, including the exportation of Chagas disease and its vectors. As in many Latin American countries, employment of migrants is often refused on the grounds that people from endemic areas are, or may be, carriers of Chagas disease.

Poverty and disease are inextricable

Which problem should be treated first, disease or poverty? This is not a simple question. Both in developed and less developed countries modern research emphasises new drugs, vaccines, and improved insecticides. This research has produced several hundred scientific publications, yet the question of rural poverty remains largely ignored. "But we cannot afford to rehouse everyone in vinchuca-proof houses" say the planning ministries, already struggling with fragile economies and booming energy bills. Perhaps not, but must we accept the current status of the problem, approach it in medical or entomological isolation, and continue our quest for a miracle drug,



Figure 4 Outstanding were the "axe-breakers"—quebracho—which gave rise to a timber industry



Figure 5 Eventually, overgrazing by cattle and goats, and tree felling, produced an unproductive landscape of scrub



The typical homestead of the now degraded Chaco has a corral or a wonder insecticide? Instead, is it possible that a better understanding of the links between the management of natural resources, patterns of land use and standards of living, might improve or approach to the problems of disease?

In the Argentine province of Salta, on more than 300 000 hectares of impoverished Chaco, a vigorous group of forest engineers have adopted a different approach. Their key words are "commercial management" and their objective is to exploit the area profitably by restoring and maintaining the forest in a productive cycle. The project leader, Carlos Saravia Toledo, is a well known plant ecologist, and also a large landowner; he has used his own land to try out the management scheme—a trial run of more than 20 years.

Crucial to the scheme is to manage large areas, each of more than 60 000 hectares, for timber, charcoal, and beef. Each of these management units can sustain a small town provided with essential education and health-care. The unit is divided into 15 000 to 30 000 hectare sub-units which are fenced to keep out cattle and goats. Then, in progressive sectors of about 100 hectares, all fallen wood is dragged out and almost all the trees and shrubs are felled to provide hardwood timber and fuel for the charcoal ovens. One consequence of removing fallen wood is to reduce ground-nesting rabbits (*Pediolagus salinicola*) which take refuge among fallen logs and can cause severe damage to young hardwood trees. In each sector, a few mature trees of the most valuable species (particularly quebracho and ironwood) are left standing to provide seeds for natural reforestation. Seeds of wild grasses are added where regrowth is poor and the area is left undisturbed and protected from cattle until the young hardwood saplings are large enough to be immune to grazing, although limited grazing may be allowed during this time

to help disperse grass seeds spread in the cattle dung. After about five years (and then periodically when necessary) when the young trees are about 2m high, Toledo's workers thin the saplings and cut all undesired woody plants to produce charcoal and relieve competition with the young hardwoods. Grazing is then allowed under controlled conditions with no more than one cow to four hectares, which provides beef while allowing the grass to maintain itself and the hardwoods to mature. This careful level of stocking improves substantially upon the present capacity of the western Chaco which, in its degraded form now rarely supports more than one cow per 15-30 hectares. At intervals of about 20-40 years the mature hardwoods can be felled for timber.

Thus, the whole area is composed of sectors each in a different stage of exploitation; while some sectors are producing good quality hardwood timber, others are producing beef and charcoal for the steel industry (and for the traditional Argentine "assado" of charcoal-grilled beefsteak). By this careful management the productive cycle can be maintained, providing profit and employment for the rural people. This, then, is a triumph of "management" over "conservation" or uncontrolled exploitation—but the social consequences are deeper than this.

There is a new town in the Chaco, built, from wood, around the sawmill and the charcoal ovens. It is a shanty town compared with, say, Buenos Aires, and has only the most basic facilities. But a simple wooden shack is provided for each family, complete with generated electricity and access to water piped from wells. A small school provides primary education and free luncheons. This is probably the only town in the Chaco to show a consistent increase in population over the last few years.

Widely dispersed, unproductive rural population has been concentrated in a rural area around a self-supporting rural industry. In this way, central services, such as health care, education, and sanitation can be provided. Any treatment of houses, such as spraying with insecticide, can be carried out in days, rather than the months required if the community remained dispersed. Many of the logistic, economic, and administrative difficulties of disease control have been defeated.

The blood-sucking insect carriers of Chagas disease can be recognised, denounced, and treated. Transmission of the disease can be stopped not by technologies still in the future but by existing methods. The sad cycle of over-exploited land, poverty, disease, and urban migration can be interrupted—not just by treating the disease or by charitable alleviation of poverty, but by beginning with the land, studying it, and learning to use it in a self-enriching, productive system of land management. □



The new town at Salta, Argentina. Humble—but the beginning of economic revival

Can the Japanese really innovate?

Japan, so often envied for the impressive way it runs its technological industries, wants to increase its research so as to produce more original ideas. But all the signs are that this will be difficult

Terry Boardman Why have so few Japanese won Nobel prizes? Is the country's research original? Is Japanese industry's R&D strength a mirage? These are burning questions in Japan at the moment. Many Japanese people feel considerable pride that their nation has overtaken the West in certain technical areas. But people in industry, government and education have a nagging suspicion that the country may lack the necessary human resources—originality and an innovative spirit—to become a leader in science and technology.

A recent issue of the Japanese *Economist* emphasised, perhaps unwittingly, the way in which Japan borrows ideas from abroad. The magazine justified the need for a new spirit of innovation by referring to the ideas of two eminent Western writers, Alvin Toffler and Joseph Schumpeter. In science and technology, the country has come a long way fast by skilful adaptation and imitation. Why do the Japanese now feel they need to develop their own original research? What are their plans for producing it and above all, what difficulties will they encounter?

This is not the first time Japanese have debated their lack of originality in science. In 1915, a bill calling for the establishment of Japan's first Institute of Physical and Chemical Research stated that "... science is the source of Western power today. We have equipped ourselves more or less adequately with the material aspects of civilisation, but in the realm of scientific research ... we are still doing little more than following or imitating others."

The bill's authors noted that in "... our country especially, given its dense population and paucity of industrial raw materials, science is really the only means by which industrial development and national power can be made to grow". Some 30 years later, in 1947, a report by the American National Academy of Sciences observed that the Japanese "still lack a broad base of scientific and technical understanding ... [and] the influence [of science] on the country is limited. Science is still regarded as the exclusive possession of a privileged few". The writers of the report felt that these were conditions "which time and the democratisation of political life will tend to cure".

Today, Japanese teenagers do better than their Western counterparts in tests of scientific aptitude. And Japanese of all ages flock to marvel at well-publicised scientific exhibitions (*New Scientist*, vol 91, p 236). But many of the problems highlighted in the past remain.

Two powerful cultural factors go some way toward accounting for the concern of many people in Japan with scientific research. The Japanese are obsessed with social ranking and have a strong awareness of history. They want to catch up with their "superiors" in research; and feel strongly that they are moving into a new era in which original science is important.

A typical person in Japan sees a world populated by many social superiors and inferiors, but few equals. This hierarchical view extends to social groups such as schools and companies—and even whole nations. Serious journals report that the West—which they describe as Japan's "teacher" or "mother"—has "disappeared" or "become ill" and that Japan, the diligent young child or student, must find its own way forward. Other articles note, almost shamefully, that most purchasers of Japan's technological ideas have been Japan's "inferiors" in terms of interna-



Chiron Press/Tokyo
Barry Fox
Japanese firms are good at making electronic products, but they fare less well in encouraging creative thinking

tional ranking: Korea, Taiwan and countries in South-East Asia and South America.

In 1978, Japan paid foreign organisations £522 million for technical ideas (through licensing agreements and so on). Exports in this area came to just £115 million. Measured against the US—a country that Japan has caught up with, or bettered, in many areas of industry—Japan is still a long way behind in the quality of scientific research. According to a US National Science Foundation report of 500 crucial technological developments between 1953 and 1973, 254 were American and only 26 were Japanese.

The Japanese are very conscious of changes in time and atmosphere. History is seen as blocks of eras or *jidai*. For a Japanese person, it is most important to sense when the *jidai* is about to change so that he can keep up with his social or national competitors. The most recent historical era was the *Boeki-rikoku jidai* of 1945–1980, in which trade with other nations was all important. Japan is now seen to be moving into the *Gijutsu-rikoku jidai*, or high-technology era, in which the country must stay ahead of



its national "inferiors" and compete, mainly with the West, in advanced technology.

The Japanese are only too aware that most of the goods they export can be produced in the West, and they are anxious to develop their own original research for goods that the West does not, or cannot, make. But they have a big leeway to make up. Kawata Katsushi, the president of Nissan Motors, has admitted: "Most of the original technology [in cars] comes from the US. Japan can make good cars efficiently, thanks to its diligent labour force, but lacks its own technological developments."

In electronics, for every tape recorder that they sell to Europe, Japanese firms have to pay a substantial sum to the UK. The cash represents licence fees on British-designed Dolby-tape noise suppressors contained in the machines. In life sciences, Japanese-owned patents account for only one-fifth of those currently valid in Japan; the rest are mostly American. The Japanese also lag in other key areas of research: energy, marine studies, information processing and medical, education, communications and welfare-related technologies.

Government increases research funds

How do the Japanese intend to develop their own original R&D to meet the demands of the changing *jidai*? The government is stepping up its own research effort, and has made it clear that it expects Japan's big companies to do likewise. This year the government is spending £200 million on research into what it calls the "next generation of basic industrial technology"—materials processing, automation and so on. It is also allocating £10 million to stimulate original research in science, increasing to £200 million by 1990.

For its part, industry intends to develop original research by increasing competition. Hitherto, the big firms have tended to collaborate in many areas of research, information often being exchanged informally by young researchers who know each other because they went to the same schools or colleges. In recent years, businesses have said they want to hire more young people with originality. And the government intends to attract to Japan foreign researchers—not to tell the Japanese how to build or manage operations, but how to think in more original ways. According to the physicist Yukawa Hideki, this policy is in accord with the long-established Japanese philosophy that originality and cultural stimulation should be found abroad, not in Japan.

By setting up new research centres staffed with imaginative people, the government hopes it can side-step the inertia in Japanese universities and in the education system as a whole. The universities, many observers recognise, are beyond the pale when it comes to cultivating originality. Japan's system of professorship helps to stifle innovative thinking. The Japanese believe that researchers should study under just one master, so each university department has only one full professor. He remains in position until death and gets all the publicity and credit for his juniors' work. Frustrated young researchers often have to move abroad or even outside their subject to win promotion.

The Japanese are trained to be unoriginal from an early age. Schools do little to stimulate creativity. In the eyes of

society, a young Japanese has to enter a university if he is to stand any chance of progressing in life. So all education is geared to getting pupils through the universities' entrance exams: the process often starts at kindergarten. Because of the sheer number of applicants, universities set examinations which comprise sets of questions to which candidates have to give short, simple answers, and so are easy to mark. But the exams test knowledge, not thinking. So schools place little or no emphasis on originality in science education. This is despite the words "... and developing creative ability" which trail along sadly at the end of each paragraph stating course objectives in the education ministry's guidelines for science teachers.

Furthermore, schools place great emphasis on group activities to an extent inconceivable in the West. In these, children are encouraged not to stand out or excel: the aim is to fit it, to become "average".

Optimistic businessmen say that Japan has not progressed in science research because the government has grown used to regarding pure science as a luxury. It has concentrated on funding application-orientated research to make the country economically strong. Increased research grants will solve this problem, the businessmen believe.

But Imahori Kozo, professor of biology at Osaka University, notes that research grants have been increasing at a rate of 15-20 per cent each year over the past decade. Yet no one can point to a growth in original thinking over this time. For instance, there has been no leap forward in the number of Nobel Prizes won by Japan. Before Kenichi Fukui won the 1981 prize for chemistry last week, only four Japanese had won a Nobel Prize—only one more than Australia, which has one-eighth the number of inhabitants.

Some observers point out that young people in Japan are gradually becoming more like their Western counterparts. To be sure, more of them are wearing jeans. But they do not necessarily act more like individuals instead of behaving as part of a group. Professor Nakane Chie in her book *Japanese Society* (Penguin, London, 1973) says that "... young people soon begin to follow the traditional order once they are employed, as they gradually realise the social cost that ... infringement involves". If Japan's plans are to succeed, its scientists, particularly the young ones, will soon have to shake off their "safety-first" mentality and start innovating. All the signs are, however, that the effort will be an uphill struggle. □

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F O R U M

There is nobody out there!

Tony Jones reviews one man's resistance to the idea of extraterrestrial intelligence

FRANK TIPLER, the American astrophysicist supported by the US National Science Foundation, and who irritated his colleagues by announcing that black holes are impossible (*New Scientist*, vol 88, p 95), has done it again. He has turned his mind to the problems of extraterrestrial life, arguing that we are the only intelligent species in the Galaxy. And he has now published a remarkable claim that the "supposedly sober scientists" who advocate searching for extraterrestrial intelligence are driven by the hope of "semi-religious salvation".

Tipler has championed his cause through the pages of the *Quarterly Journal of the Royal Astronomical Society*—a publication from a learned body not widely noted for radical views. Yet the *Quarterly Journal* (QJ), edited until recently by Simon Mitton and now by David Hughes, has a happy tradition of airing thoughtful, critical and often controversial articles on anything remotely connected with astronomy. Tipler's papers take their place among others with names like "Meteorochemical flying objects" and "Was Ptolemy a fraud?".

In his first paper (QJ, vol 21, p 267) Tipler argues that any civilisation only slightly in advance of ours would have already colonised the Galaxy, including our own Solar System. Because we have not been colonised (it seems), such civilisations do not exist. The key to galactic colonisation is a "universal constructor" or von Neumann machine—an intelligent robot able to synthesise any required artifact, including copies of itself. (John von Neumann was the Hungarian mathematician who showed that such a machine was theoretically possible.)

A highly intelligent civilisation wanting to explore the Galaxy on a low budget would not fit about in Enterprise-type starships, but send a von Neumann machine to the nearest solar system using conventional rocket technology. On arriving in the target system the probe would use raw materials in the form of planets, asteroids and comets to manufacture and fuel a new generation of identical machines. These offspring would then set off for other stars and so on until the Galaxy had been explored.

The probes would be programmed to search for extraterrestrial life and transmit news back to the home planet. They could even carry the genetic code of the beings who launched the original machine and synthesise colonists for any likely-looking planets. Tipler reckons that in this way the Galaxy could be explored and colonised in less than 300 million years at the cost of the original probe (comparable with the cost of the Apollo programme). The Universe is at least 10 billion years old, so if they

haven't come yet, says Tipler, they aren't coming at all. In other words, such civilisations do not exist.

One counter-argument says that any civilisation bright enough to build a von Neumann machine would long ago have evolved sufficient Tiplers of their own to convince themselves that they were alone in the Galaxy, and so would stay at home. Thus the observed absence of colonists could be a consequence of a Galaxy brimming with Tipleroid civilisations, each contemplating their navels (or equivalent), while stoically coming to



terms with the cold thoughts of their awesome cosmic uniqueness.

Tipler brushes off such objections by pointing out that von Neumann machines would have so many other uses (mining asteroids, space construction, etc) that an intelligent civilisation would be silly not to capitalise on them and colonise the Galaxy as a kind of technological spin-off.

There are deeper questions about the assumed motivations of extraterrestrials, but Tipler is more concerned with the motivations of the scientists looking for them. It is nowadays rare for a scientist to use the academic press to cast aspersions on his colleagues' motives, but Tipler does not let that social nicety get in his way (QJ, vol 22, p 279). Not only is the existence of extraterrestrial intelligence taken for granted, he says, it is now established doctrine based not on scientific evidence, but on semi-religious faith. He cites as an example his attempt to get his papers published in the American journals *Science* and *Icarus*. On both occasions they were stopped by Carl Sagan, a leading advocate of the search for extraterrestrial intelligence (SETI). This is common, claims Tipler, who sees the incident as evidence for a "save-the-world semi-religious motivation underlying the US SETI proposals", particularly in the US (British editors apparently take more kindly to papers against extraterrestrial intelligence).

Tipler notes that the supporters of the search for extraterrestrial intelligence are predominantly physicists and astronomers, whereas biologists (who should know a thing or two about life) tend to think that the chances of intelligence evolving elsewhere are very slim. He claims that Sagan and the like expect that contact with extraterrestrial intelligence will somehow save us from ourselves, and attacks such "supposedly sober scientists" as Fred Hoyle, Frank Drake ("missionary zeal") and Philip Morrison ("hope of extraterrestrial salvation").

For the hypothesis of "no extraterrestrial intelligence", Tipler claims the support of such notables as Freeman Dyson, Gerard O'Neill and (his trump card) the spectacular conversion of Iosif Shklovskii, the Soviet astronomer who wrote, with Carl Sagan, the classic book *Intelligent Life in the Universe*. Meanwhile Carl Sagan, who is best known in Britain for his *Cosmos* television series, has denied that he is expecting salvation from the stars. □

A career in science

Ros Herman has been finding out about a survey of scientists at work

WE ALL THINK we know what we mean when we say "scientist", and surely most readers of *New Scientist* can point readily to a handful of types of job they would expect to be filled by such people. But actually very little is known about what those who choose to be scientists expect out of their careers, and how they feel about voluntary or enforced changes at various stages of their professional life.

One might think that trying to throw light on these questions would be a fairly routine task for a doctoral student in sociology. But—perhaps having noticed recent reports that such students often fail to complete their work in the time available—two researchers well established in the upper echelons of the scientific community have taken the task upon themselves.

One is John Ziman, who recently gave up all pretensions to being a practising scientist by exchanging his post as head of the physics department at Bristol University for work in science studies. The other is Ray Bevertton, who, according to Ziman, built up, almost single-handed, the Natural Environment Research Council. Bevertton left NERC last summer after 16 years' service as Sir Hermann Bondi took over the chairmanship.

Ziman and Bevertton have begun by talking to senior scientists—to pin down, Ziman says, "what sort of problems they think are significant". But their answers will not be "received wisdom"—merely a pointer for the people to go to and the type of questions to ask in the next stage.

The theme of the study will be change—in particular change under pressure.

F O R U M

In an outline of their project, Ziman and Beverton point out that with resources for research on the decline, scientists have to be more adaptable than before. On the other hand scientific jobs demand ever more specialised skills and experience. How have these forces expressed themselves in the lives of individual scientists? And to what extent have scientists' attitudes been shaped by the assumptions and outlooks of the teachers and managers in charge of their development?

Ziman and Beverton hope to find the answers to these questions "by patient and sympathetic inquiry, conducted in a relaxed atmosphere with due observance of personal confidentiality". When complete, they think their results will provide a better idea of just how much versatility we can expect of scientists, and how to advise them about their own careers.

If you think Ziman and Beverton would learn something by listening to you baring your soul, they would like to hear from you. □

Great moments in democracy (1)

MEMBERS of the North London Medical Branch of ASTMS got more than they bargained for when they set out to find out about democracy in research. They invited Steven Rose to one of their regular meetings at the National Institute for Medical Research in Mill Hill to speak on "Science policy and democracy".

The institute's director, Sir Arnold Burgen, evidently has his own ideas about democracy. When he heard about the meeting he told the union that he could not allow political rallies on the premises, and to look elsewhere for a venue. □

Shed no more crocodile tears

Rupert Grey reports on the United Nations Crocodile Project

CROCODILES are flourishing in Papua New Guinea, largely because they are worth money. The government of Papua New Guinea and the Food and Agriculture Organisation (FAO) have jointly set up a highly successful conservation scheme founded on the principle that profit provides the best incentive: crocodiles are now a major industry bringing in about \$2 million foreign exchange per annum. This novel attitude towards conservation appears to suit the crocodiles, and their numbers are growing; their population is approximately 200 000, which is about one for every 15 Papuans. About 10 per cent of the crocodiles are in captivity.

The New Guinea crocodile (*Crocodylus novaeguineae*), or freshwater croco-

Salty crocodile
in Papua
New Guinea



dile, accounts for approximately 80 per cent of the population. The species was only discovered in 1928, and is one of the least-known of the world's 20 or so crocodilians. Found nowhere else, it is thought to be the only crocodilian not in danger of extinction.

The remainder are salt-water crocodiles (*C. porosus*), and their range extends from Australia to the China Sea, and India to the Fiji Islands. The "salty", as it is known colloquially, is the largest of all crocodiles; it does for Papua New Guinea what the grizzly does for Canada: provide a limitless quantity of legendary tales which get taller, and the crocodile longer, in the telling. They are regarded as the most dangerous of all crocodiles, but are also the most endangered. Their small belly skates, or scales, make the most valuable skins, and the Convention of International Trade in Endangered Species (CITES 1978) has now banned commerce in their hides. Papua New Guinea is the only country exempted from the ban.

Trade in Papua New Guinea both in saltwater and freshwater crocodile skins began in earnest in the 1950s, and by 1966 their populations were plummeting. The response of the government was shrewd; instead of banning the hunting of crocodiles—which would have been manifestly impossible to enforce among a population whose lives for the most part were spent in blissful ignorance of the government's existence, let alone its laws—it outlawed the sale of skins. Excluded from the rules are crocodiles with a belly-width of less than 20 inches, thus ensuring that animals more than three to four years old (about six feet long) which are mature enough to breed are protected.

To discourage the harvesting of the wild population, the government set up a network of village crocodile farms. In parts of Papua New Guinea, such as the Western Province where 65 000 people live in 96 000 sq km linked by 900 km of permanent road, the task has not been easy. The object was twofold: to ensure that the profits of the scheme returned to the community whence the crocodiles came rather than middlemen, and more importantly, to conserve the wild ones.

The scheme promises to be highly successful. The hunting of oversized

crocodiles has been virtually eliminated, and the sale of hatchling crocodiles to the farms not only provides villagers with their only source of income, but also actively encourages a spirit of conservation. The capture of hatchling crocodiles has an insignificant effect on the wild population, for only one out of every five hatchlings taken will survive the first year of life.

The farm population has increased dramatically since 1977, when the FAO first became involved. By 1980 200 farms were housing 17 000 crocodiles, not only producing income both locally and nationally, but also providing a source of young crocodiles which can be used to restock areas where the wild population is failing. The farm management policies are based on studies of population distributions and density indices of both species, the latest of which was completed in July last year by J. Jerome Montague on behalf of the FAO. Counts were carried out at night, by searchlight; a crocodilian eyeball is a good reflector. It is thought that 63 per cent of crocodiles actually present are seen on night counts, so that the 1112 crocodiles Montague sighted in the study area represented a total of 1765 crocodiles present in the vicinity.

The study was made possible by the cooperative efforts of the FAO, the government of Papua New Guinea, the Department of Fisheries and Wildlife at Michigan State University and Operation Drake's volunteers, whose Strickland River expedition enabled Montague to conduct his survey in its more inaccessible reaches. The significance of this study lies partly in the fact that it covers ground not hitherto surveyed, and partly in that Papua New Guinea is a country where, possibly more than anywhere else in the world, mankind has made the least impact.

It is no more difficult, indeed possibly less so, to make a profit out of crocodiles than cows. To link farming to a flourishing wild population, however, requires sound knowledge of crocodilian habits and habitat. And if there is much yet to be learned, the FAO's work makes an important contribution in this respect both to Papua New Guinea and to other countries concerned about their crocodiles. □

Standards for the unemployed

John Walker suggests how the lot of the job-hunter could be improved

UNEMPLOYMENT affects people at all levels, from unskilled labourers to PhD scientists and senior executives. Personally I was once three months on the dole and made 25 unsuccessful applications before finding a job.

Of course it is no shame to be unemployed, though very depressing. But

F O R M

what galled me was having to fill out 25 application forms, all wanting basically the same information, but each insisting it be set out differently. In most cases my typed *curriculum vitae* was not acceptable. One organisation, the UK Atomic Energy Authority, actually had different application forms for different establishments!

So what I would like to propose is a British Standard Application Form (preferably produced by HMSO and available free at any Post Office). This should present no problems, because every employer wants to know the same things: age, qualifications, experience.

There would be many benefits. Job-hunters could afford to have their particulars typed and photocopied, making for legibility and saving time for all concerned. Firms and applicants would be saved the postal costs involved in writing off for and sending the forms, and replies to advertisements would be speeded up. Some organisations, such as those involved in defence work, might need information not on the standard form, but this could be gathered later in the selection process.

My second proposal is that candidates who get as far as an interview but do not get the job should be told why they have been rejected. It might occasionally be bruising to the ego, but it would be very useful in planning subsequent applications. Furthermore, it is unsatisfactory, after attending three interviews on two separate days, and taking part in a selection board lasting seven hours and involving discussions, written tests and group exercises, simply to be told, as I was by the British Council, "We regret . . ." It seems to me to be common courtesy, and only fair to the candidate, to give him an explanation. This would involve very little extra work on the part of the selectors, since each candidate has to be reported on—an edited report could easily be communicated to the candidate.

I should add that this procedure is practised already in Denmark. After I reached the shortlist for a university lectureship in Denmark I was given a résumé of myself and the other 10 candidates, prepared by the selection committee, with a request for comments (which gave me a chance to straighten out any misapprehensions they might have had). The final verdict, with reasons, was subsequently communicated to me.

Of course, there might be problems in carrying out this procedure where confidentiality is necessary—since you may not want it generally known that you have applied for another job—but at least the candidate could be given the selector's report on himself and on the successful applicant. And it might reduce the number of cases where a post has effectively been filled beforehand but has to be advertised for cosmetic or statutory reasons.

□ Dr John Walker is now employed as an electrical engineer in the Reading region

Equitable minister bunkered

MORE LIGHT can now be shed on the mysterious sacking last month of Michael Marshall, until Maggie Thatcher's cabinet shuffle a junior minister in the Department of Industry with special responsibility for space. Marshall, a youngster among MPs (he is a mere 51), had appeared to be doing pretty well in his job and was coordinating a government rethink over what its activities in space should be.

It is now being suggested that Marshall's fondness for golf—at the expense of his official duties—contributed to his downfall. Dennis Thatcher plays golf as well—which is perhaps why Mrs Thatcher doesn't like it. Marshall, a cheery soul who is a member of the Lord's Taverners and who in 1979 edited a book called *The Stanley Holloway Monologues*, went to Cape Canaveral in April, purportedly to watch the launch of the first space shuttle. This was all part of the aim to convince the Americans that we Brits are keen on space also.

Unfortunately, the launch was postponed a couple of days and Marshall was faced with an agonising dilemma. Should he stay on to see the first shot in new era in space, or should he go to Atlanta to watch a professional golf tournament? The fun-loving Michael, who is a member of Equity and only last year brought out a fascinating book called *More Monologues and Songs*, seems to have decided that the lure of the little white ball was greater than that of the space rocket. Keen on wonderful new technology as she is, Mrs Thatcher could hardly have been impressed. □

Grant Swinger carries on

Dan Greenberg learns of ways to beat the budget cuts

NIMBLE AS EVER in courting the Washington bankroll, the legendary Grant Swinger, director of the Center for the Absorption of Federal Funds, remains optimistic in the shadow of the Reagan-Stockman budget-cutting spree.

"Adaptation is the key," he explained during a change-of-planes break on the torrid international conference circuit. "For example," he said, "we've revived an old activity that we had to mothball during the Carter administration."

"What's that?" I asked.

"The Institute for the Resolution of Conflict Through Violence. That was a big one during the 1950s and 1960s, and now it's back again with big bucks from the Pentagon as part of Project Strongarm."

"Strongarm?"

"It's part of the new program called Alternatives to Negotiations. Can't tell you too much about it, but I'd like

to point out that there's lots of new life in some of the old stuff, too. Like strategic studies. You know, if we do this and then they do that, and then we do this or that, what if they . . . And on and on. We thought it was played out, but it's got a Russian angle, and that's indispensable these days. We learned that the hard way."

"How?"

"When we struck out with our proposal for an oil-solidification project."

"Oil-solidification?"

"Remember how it was with Carter?" Swinger asked. "Anything went in energy. They were bonkers on coaliquefaction, so we figured we'd take the next step and . . . But, like I said, no Russian angle. So, we dumped it and we regrouped around MX."

"Isn't MX resolved as a subject for research?" I asked.

"Oh, no, that's really just beginning. This latest decision is going to produce new panels, commissions, conferences, reports—it's open-ended, even though there's nothing new to be said. But even if we don't get another grant out of MX, we can't complain. We had a good five years on trucks versus trains, midget subs, airplanes, shelters in the desert, and then, of course, all kinds of combinations of them. We were putting in overtime, and then just when it looked like the end was in sight, one of our bright fellows came up with a blockbuster of an idea that brought another load of loot from the Pentagon."

"What was that?"

"He raised the possibility of doing nothing—no MX, so nothing to hide. That was there all along, but it takes a special kind of mind to spot it in all the policy clutter. So, we went back to the beginning and studied doing nothing. We started with a big conference, broke up into workshops, and soon we'll have panel reports to send out for review, prior to reconvening the conference. We're going to do the same thing with the B-1, battleships, rapid deployment, the draft, chemical warfare, and AWACS. It's a new dimension in policy studies."

"What else?"

"Japan. That's shaping up a big one. When you can get the Reagan crowd to take its mind off the Russians, you can get them to worry about Japan. We're hitching that to genetic engineering, and we're working on a pony-size chicken. We call it Mega-Chicken. We've got to beat the Japanese to it. We're also into 'quality circles', what-

IT'S INCOMPATIBLE
TO JAVA! PECKS
RUSSIANS AND
LAYS BROWN EGGS





ever they are, but, clearly, they're hot."

"I see."

"These things come and go," Swinger pointed out. Remember civil defence? It was thriving for a time, but then the bottom dropped out. The same with pollution, ecology, population control, oceanography, and on and on."

"Any mileage left in the social sciences?" I asked.

"We used to do very well with poverty, but there's not much in that now," Swinger replied. "We're under contract to the school lunch programme to study how little you can feed kids before malnutrition hits. We're trying to get this tied in with a sludge-conversion project, but the Reagan people tend to be slow in approving these things. Unless, as I said, there's a Russian angle."

"Then it looks as though these are very different times for the Center for the Absorption of Federal Funds."

"Not as much as you might think. Actually, there's more money floating around than ever for our kind of work, but you've got to be able to pitch your case to the politics of the moment."

"Do you think you'll ever run out of grantable subjects?"

"Not likely," Swinger replied as his flight was called.

"By the way," I said, "where are you going?"

"First to a conference on technological lag," he said, "and then to a conference on terrorism. Believe me, we're busy."

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chicken fame with whom I've been confused before when she ushered us into that Athenaean of Terminal Three, the Executive Lounge. No matter. Within seven hours and a long look at Baffin Land and the Rockies on the way we great circled down to that massive city of make-believe known to the Hispanic Founding Fathers as El Pueblo de Nuestra Señora la Reina de Los Angeles de Porcuncula. And now for some almighty assemblings of points south down into Mexico.

As the majority of journeys these days—with the possible exception of those made on foot—are easy to make but hard to justify, we went to California first because we were invited to several places, and second because for years I've had an itch amounting to a passion just to see the Pacific and what the sea mounts and off-shore shelves do to the rollers. They are prodigious. At stately intervals each one gives the impression that it is about to inundate the whole beach and the lagoons, but the distance between the swash and the backwash is relatively small. With very little in the way of protection, parts of the coastal railtrack run close to the upper tide-line, but a conductor assured me that never in his day had they ever been swamped. As for the deserts they are possibly hotter but certainly better clothed in vegetation than any I have seen in Africa. San Diego zoo is superb tropical. There can't be anything better anywhere else. The Scripps Institute of Oceanography at La Jolla, a shrewd professional critic told me, is not what it was in the days of Roger Revelle and the late great John Isaacs. I found the coastal fauna and flora profuse. The thin slices of Mexico we managed to see were too varied and colourful to be set down simply and much the same could be said for the Californian way of life.

La Jolla could scarcely be reckoned typical. It is a place where a person's social standing is judged by the number of seaplanes parked alongside his marina for the Sunday dispensation of lobster claws, sweet gherkins and Margaritas which, as I understand it, are compounds of tequila and an extract known only to Zapotec medicine men. The smell is of vapourised sun-tan oil and resinous pine. The shops that overlook the Pacific thereabouts include august branches of Tiffany's, Gucci, Saks of New York and a bank which in big letters assures its clients that there are "No penalties for

premature withdrawals". I read the notice twice and walked towards a religious bookshop ("Gospel Seed") repeating the words, slowly. And yet the desert isn't far away. During our second night in nearby Del Mar, two coyotes slunk up from the lagoon below and carried off our host's cat. They are on the increase everywhere and have reached the outskirts of Los Angeles.

After visiting the famous La Brea tar pits in that city we went to the Natural History Museum to see a few of the fossilised bones of the world's largest flying bird, *Argentavis magnificens* from some Miocene beds in Argentina. A huge creature, a teratorn somewhere between a condor and a vulture which had a wing span of 35 ft (10.7 m). But of that more later. As you must be, I'm tiring of superlatives.

Let me say simply that of all impressions of the trip, the hospitality, the attentiveness of almost everyone we met stood out as bright as the lights of Las Vegas at midnight which are quite something. If LA is the smogopolis of the Golden West then all I can say we saw none of it. And far from having nothing in the way of public transport—as we had been warned—we travelled the length and breadth of that city by bus, cheaply.

On a more light-hearted note I treasure a song by the Cheap Suit Serenaders entitled *What Do Clones Do on Mother's Day?* I should like to hear more of Mr Bink and his trio composed of a musical saw, spoons and a vacuum cleaner. Musical saws are staging a come-back. Mae West, a real old trouper who died in Hollywood not long ago, was said to be real fond of the instrument. Could that have been the origin of "Come up and saw me sometime"?

Beth Ann Krier who covered a recent saw festival in Santa Cruz for the *LA Times* said the event had some real teeth in it. She should know. She has saw—sorry—seen most of the saw players including that veteran Tom Scribner who can play a treble, baritone and bass. It seems you can get over

Californian sketch book (1)

John Hillaby returns from the far west

ALTHOUGH it's a pretty far cry from Helvellyn to La Jolla in Southern California, Katie and I undertook the journey partly on foot and partly to reassure ourselves that Sam Johnson, another good walker, knew a thing or two when he laid it down firmly that while marriage has many pains there are no pleasures in celibacy. My recollection is that the circumstances that led up to our formal conjugation on the Feast of St Ambrose were mentioned on these pages in the spring (2 April, p 42). Enough to say that to get into the swing of things we hustled along from the Lake District to London by way of the Humber, the Wash and the Wissey in the Brecklands carrying a Goretex igloo in which you could have seduced the front line of a hockey team.

Thereafter, and smartish too, to assure my child bride there was more to life than boots, maps, Band-Aid and baked beans, we flew off to Los Angeles and coastal points south into Mexico with some help from British Airways and the users of Barclays West Hampstead. I still think that natty little stewardess at Heathrow thought she was dealing with Colonel Sanders of Kentucky fried

CONTINUED FROM PAGE 34

third voice is the most advanced of the three, possessing "by far the largest vocabulary of any machine using a high-quality speech model". From the mountains in contrast to the phonemic drool of many computer-programmed voices, this third voice will sound distinctly human. It certainly should, since it is the voice of Bob Guccione.

Each word spoken by Guccione will be converted into binary bits. When it is recorded, the robot's echoloma chamber, says Savage, Eventide, OmniVox will be able to use 850 words from Guccione's vocabulary enabling the robot to express virtually any concept in the English language.

What makes the Omni robot story so historic is that it reflects the dominant theme of our age: the need to control our own

From *Omni's Special Anniversary issue*

F O R U M

eighty notes out of well-tuned cross-cut either clouting it with a mallet or using a bow, but for the bigger two-handed jobs used by loggers you need arms like an orang-utan. But then as Ron Reagan said when he was asked about the future of the giant redwoods: "If you saw one you saw them all." □

British Steel's EuroRoute

Tam Dalyell MP contemplates some pipe dreams for Europe

SUCH THINGS can never be proved or disproved—but let me guess at the most cost-effective way of influencing events. Hire a hotel room—a big one will cost £100—provide sandwiches, sausage rolls, and bowls of hot soup, with some red wine, and invite delegates to a Party Conference at the seaside to a lunch-time presentation of your proposal. This is precisely what British Steel did at the Metropole Hotel at Brighton, and at Blackpool. And thereby it established its EuroRoute pro-

posal as a more serious political runner than hitherto.

Let me explain. Until they heard the case for a practical road and rail crossing of the Channel, properly presented, with film, by senior representatives of British Steel and Lazard Brothers, most MPs would have giggled at the idea of a bridge-tunnel-bridge spanning the 36-kilometre gap between France and Britain. But when MPs heard the chief executive of EuroRoute, K. W. Groves, and John Hervey-Bathurst of Lazard, explain the idea, the smirks disappeared from their faces. The suggestion is a crossing that incorporates two two-lane carriage-ways and two rail tracks. The railway is to be carried in a submerged tunnel tube throughout the crossing. The road carriage-ways are to be carried on twin viaducts across the inshore shipping zones of the Channel, and in a common submerged tube tunnel structure with the railway beneath the main shipping lanes. The transition for road traffic from viaduct to tunnel would be within offshore artificial islands, constructed at the boundary of the main shipping lanes, providing an 18½ km wide passage way, for tankers and others.

What MPs found particularly attractive about this proposal was that it goes some way to meet the problem that has nagged so many of our constituents, about the reactions of drivers after spending a long time in a tunnel. Viaducts rather than tunnels are to be used to carry the road across the inshore zones, so as to minimise the length of the tunnel. The 18½ km would keep the actual tunnel section within known limits for driver reaction, and would allow a sufficiently rapid response time for emergency services. The tunnel ventilation system for road traffic would be designed to cope safely with the worst conditions created by exhaust fumes, with the crossing operating at full capacity.

The scheme MPs heard about proposes the use of the railway tunnel in the central section as a fresh-air inlet duct. We were assured that preliminary calculations indicate that this concept, which reduces capital costs appreciably, is feasible. Fresh air will be introduced, and exhaust air expelled at three intermediate ventilation islands, and at the main islands. The capital cost of the construction of such a crossing at mid-1980 prices is estimated at £3800 million. Total employment in the construction, shipbuilding, and construction-related industries is estimated to be over 250 000 man years. Overall employment, including subsidiary work generated as a result of the project's construction, is reckoned to give a total employment figure for the full construction period of 500 000 man years—and in many parts of the United Kingdom. Like many MPs, I would give the construction of a gas-gathering pipeline top priority, but I believe that on energy-saving and employment providing grounds, we should also go ahead now with the Channel project. □

I-spy Howard Hughes

Stephanie Yanchinski has discovered some new support for genetic engineering research

NEW SCIENTIST has it on impeccable authority that the Howard Hughes Medical Institute (which arguably funds some of the best genetic engineering research in the United States) wants to set up a British base. Like many organisations involved in genetic engineering in the US, the institute has its sights on the untrapped pool of British researchers, some of whom are not a million miles away from an MRC unit at Cambridge and a London-based medical charity. But the front runner is probably an Oxford DNA don, whom HHMI believes would welcome some dollars.

Hughes's money provides fellowships as well as equipment and laboratory space. The "fellowships" amount to the entire salaries of selected recipients. Over the past decade the institute has "acquired" 75 investigators, spread over 12 American universities, to do research in genetics, endocrinology and immunology. Each year it spends between \$20 and \$25 million. At the University of California, San Francisco (UCSF), the institute supports some of the biggest names in genetic engineering, including John Baxter, Herb Boyer (joint owner of the Cohen/Boyer Patent), Howard Goodman, and Y. W. Kan.

The HHMI connection has upset many at UCSF. HHMI dollars are not channelled through the accounting department nor the Office of Grants and Contracts. Instead, the Hughes institute draws up separate contracts for research budgets which are handled outside departments in which they work. So Hughes does not have to follow university salary scales and this has put the noses of poorer brethren considerably out of joint, not surprisingly.

Other issues which have angered faculty members in UCSF's Department of Biochemistry include control of Hughes influence, peer review of research ideas, and the "citizen responsibilities" of Hughes fellows.

Assistant Professor Keith Yamamoto also asks, as I did, what is the ultimate aim of establishing a network of Hughes researchers dotted around universities in the United States and elsewhere? George Cahill, HHMI's research director, insists that the objectives are philanthropic—to fund good research. However, the institute's low tax status also helps Hughes Aircraft Company to ease itself of at least some of its enormous tax burden.

Yamamoto also emphasises that these handpicked researchers have "got used to a high standard of living both in and out of the laboratory". He is worried about the pressures HHMI could eventually bring to bear for some as yet unforeseen purpose. □

ENIGMA

No. 133

Are you positive?

by Susan Denham



ONE A 3-by-3 array like the one shown, I have coloured some of the little squares black and left the rest white. The four 2-by-2 corners of my pattern look like



These are not necessarily the right way up and some, unfortunately, may be the negatives of what they should be. Sorry! But if I told you the colour of the middle square in the top row of my pattern and I told you the number of black squares in my pattern, then you'd be able to work out my pattern (the right way up too!).

Send in a copy of my pattern, or the negative of it, whichever takes less shading.

A £5 book token will be awarded to the sender of the first correct solution opened on Thursday, 12 November. Please send entries to Enigma No 133, New Scientist, Commonwealth House, 1-19 New Oxford Street, London WC1A 1NG. The Editor's decision is final. The winner of Enigma No 130, Lettered league was J. D. Stride of London.

Answer to Enigma 130

Lettered league

A v B, 55	A v C, 24
A v D, 21	C v D, 84

L E T T E R S

Nobel families

"This Week" (22 October, p 224) states that the Siegbahns are only the third parent-and-child pair to win Nobel Prizes, being preceded by the Curies and the Braggs.

Surely we should not forget another illustrious British family, the Thomsons? Sir Joseph (the famous "J.J.") is universally acknowledged to have discovered the electron, and was awarded the physics prize in 1906. His son, Sir George, sometime master of Corpus Christi College, Cambridge, was awarded the physics prize in 1937 for his experimental determination of the wavelength of the electron. The latter's son, incidentally, married the younger Bragg's daughter.

Norris K. Haugh London

Rutland water

I was deeply concerned by the grossly misleading statements made by Fred Pearce ("Water, water everywhere . . .", 8 October, p 90) about Rutland Water.

Rutland Water is not a "folly", it is not "redundant", it is not "superfluous", and his statement that "none of the water has been needed" is completely untrue. The reservoir has been in use since 1977 and has supplied 33 000 million gallons to those areas which it was primarily designed to serve.

The water which is used has to be replaced and as Rutland is not a collection reservoir supplies have to be pumped to it. The annual cost of doing so is £300 000. To suggest this is the cost of replacing evaporation is wholly incorrect; it is a planned operation to replace the water supplied to customers.

So far as this authority is concerned, we do not have a "guilty secret" with regard to water resource planning. We always clearly set out our plans, which are approved by the authority, together with the

assumptions and data on which the plans are made.

This authority has put great emphasis on the forecasting of water demand, reviewing its forecasts annually and carrying out extensive water use studies to help the forecasting process. As a result of this work, the demand forecast which the authority inherited has significantly reduced. In addition, the authority has also carried out about 150 investigations into a wide range of resource development options, not including the classical forms such as the building of reservoirs. As a result of these two main activities, schemes such as the development of storage in the Wash Estuary and the use of water from Wales were shown to be unnecessary for very many years.

Nevertheless, our forecasts predict a significant increase in demand in comparison to other regions for the simple reason that Anglian has been, and is likely to continue to be, the most rapidly expanding part of England.

G. E. Bowyer Huntingdon
Anglian Water Authority

Datura

Congratulations to Susan Watkin on her close encounter with *Datura* ('Forum, 8 October, p 120). Does she know she is in the imperial company of the Grand Moghul, Shah Jehan, the builder of the Taj Mahal? He had a closed encounter. He was imprisoned by his son, Aurangzeb (a model form of regal inheritance in those days around here) and treated to a daily dose of *Datura* seeds, facilitating a slow and steady dementia and death.

N. Balasubramanian New Delhi

Fast train power

The controversy over the power supply to the Advanced Passenger Train ("The great high-speed train race," 17

September, p 710 and Letters, 15 October, p 192) raises several interesting technical and historical points. The Japanese Shinkansen trains are multiple-units with several operating pantographs per train, so why is it thought impossible to use more than one on the APT? The Siemens & Halske and Allgemeine Elektricitäts Gesellschaft electric railcars used in the Zossen tests of 1901-1903 each had two triple collectors for the 50 Hertz/10 kV power supply (incidentally, these cars achieved 131 mph, so Mandel never held the world rail speed record—only the steam one).

Alasdair Beal's question on why power cables cannot be carried along trains has a historic answer. The 1898 multiple-unit trains for the Waterloo and City tube railway had 11 cables carrying 500 V direct current running the length of the train so that the four motors could be operated directly by a single controller. This practice was frowned on by the Board of Trade and was forbidden after a fatal fire in the Paris Metro in 1904 which was caused by the severance of such power lines along a train. No doubt a similar possibility is countenanced by the present authorities.

Nigel Pennick Cambridge

Wanted, new ideas

Thank you for Ziauddin Sardar's article ("Last chance for world unity", 6 August, p 534) on the background to UNEP. *New Scientist* occasionally has some superb articles on Third World development, that are most helpful to my work. Being involved in an area that Sardar considers key to the problem, ie, doing R&D, and training local people to do R&D, in renewable energy resources, I have some comments.

Historically what has changed is not the attitudes of the Northern nations—they have

always been colonialists, dominating and oppressive—but in the words they use. In particular US and UK politicians talk at great length about "equity, equality, justice, democracy and people's rights", but seem surprised when people of the South take these words seriously. Few people take the leaders of the USSR literally when they speak of "democracy", and "assisting the people of Afghanistan", but Western leaders are just as hypocritical and "double-tongued". Perhaps Thatcher and Reagan are more honest in reducing foreign aid and increasing arms, since these reflect the real attitudes in developed nations.

The answer seems to be to use what is available, in the form of aid and other benefits from the West while rejecting that which lies behind it. Nepal seems to manage to balance aid from many sources, the United States, the USSR, India, China, UK, Germany, while denying all allegiance to any of them. We have no conscience about purchasing simple goods from overseas and copying them although the industrial capability in Nepal is limited.

The real problem, however, is developing a way of thinking and approach that would allow Third World nations to develop their own science and technology. There are very few original thinkers, especially in the field of renewable energy, in the Third World. There is an unfortunate tendency to copy Western patterns of R&D, both in the use of elaborate equipment, and even in the choice of subjects. The vast growth of literature and research effort into renewable energy, especially bio-gas, is based on very few actual innovations and new ideas. The same information seems to be circulated around all the new journals until it completely buries anything of use. Ultimately what is needed

Grimbledon Down



L E T T E R S

of the Division of Combined Operations to which Bernal, Pyke and myself had been assigned; an RN captain from the naval architect's department, who had been posted to Combined Operations; another RN naval architect who represented the Admiralty; the late Sir Charles Goodeve FRS, then the deputy controller for research and development at the Admiralty; and Lord Cherwell. No other member of the staff of Combined Operations was involved at the time. There was another strange meeting which I attended in a flat in Albany where Pyke was living at the time. He happened to be ill and insisted that Lord Mountbatten visit him. I have given an account of the meeting in my book, *From Apes to Warlords* (p 159).

As I said in my first letter (20 August, p 490) the idea of *Habbakuk* was put forward in the summer of 1942. Not long after, Dr Max Perutz was called in to study the properties of fortified ice. At the Quebec Conference in September 1943, that is to say about a year later, Lord Mountbatten demonstrated to the Joint Chiefs of Staff, the American President, Franklin D. Roosevelt, Winston Churchill, and others, the impenetrability

of a block of fortified ice age as compared with that of ordinary ice.

Immediately after, it was arranged that Perutz should go over to the United States and Canada to pursue his work. To make this possible, Perutz, then an Austrian subject, had to be naturalised. The ceremony took place on 3 September, and he was immediately flown over to the United States. When he arrived he discovered that the rest of the British team that had been sent over to work on *Habbakuk* were cooling their heels in Washington. He accordingly made a trip to Canada to visit the Canadians who were carrying out tests on ice and pykrete and who had built a model ice ship. He then returned to Washington where he soon learnt that the *Habbakuk* project was to be abandoned. Before the end of 1943, he and the rest of the British team returned to the United Kingdom. *Habbakuk* had lasted no more than about a year.

There were three immediate reasons why the idea of *Habbakuk*, imaginative as it was, was so quickly abandoned. The first was that it was too demanding on supplies of steel that its construction would have

interfered with other more urgent shipbuilding programmes. The second was that by the end of 1943 the range of land-based aircraft was increasing so rapidly that there was no operational utility to floating islands made of fortified ice. The third was that Portugal had by then allowed the Allies to use the Azores as an airbase.

Perutz (to whom I am indebted for information relating to his own part in the project) has said that, given that a vast aircraft carrier made of fortified ice could be constructed, its navigation would have created enormous problems. He has written that "the question [of *Habbakuk*] was not so much one of its absolute feasibility, but of whether the strategic advantages to be gained by the bergships were in proportion to the manpower and materials needed for their construction." Zuckerman

Norwich

Chorisia, by Marianne North

her gift to the nation is not constantly revalued in sales, it is much undervalued by being unnoticed. But to have so effectively come late in life to paint the flowers and scenery of the world makes her a most singular Victorian lady worth a reference at least.

JAMES R. WOOD Richmond

Victorian artist

RICHARD FIFIELD In "Art in the service of science" (15 October, p 182) omits any reference to the gift exhibited in the Marianne North Pavilion in Kew Gardens. Probably because

Correction

In our issue of 22 October, and through no fault of the author's, we stated (p 248) that the lead content of soil samples from Katowice reached 8890 mg/kg. The correct figure is 890 mg/kg.



Health is more than medicine

Our health industry is a federation of dozens of professional and geographical communities. Conscious of their independence, each group jealously guards its corner in a constant battle for scant resources and for status. Yet there is an underlying consensus; everyone works together to keep the rest of us alive and well.

Until now, the health community has had no newspaper of its own, which is why The Times Health Supplement has been created. It is designed to be essential reading for those who share responsibility for the management of health care: the people who implement policy and those who create it.

Primarily, The Times Health Supplement aims to inform, and to help. It will be a bridge between occupations and professions, common ground for an industry fragmented by too many divisions and distinctions. As a platform, it will be sometimes a forum for measured debate, sometimes a cockpit for impassioned dispute.

As an independent newspaper, in the tradition of The Times, The Times Health Supplement will have views of its own. It will set out to stimulate and challenge, question and probe, analyse and compare – and sometimes to judge. It will also aim to be accurate, responsible and balanced, and to become an authoritative voice in the health of the nation.



THE TIMES HEALTH SUPPLEMENT

The newspaper of the health community.

On sale at newsagents every Friday. 45p



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APPOINTMENTS AND SITUATIONS VACANT

Biotechnology at Searle

G. D. Searle has a major commitment to recombinant DNA technology and continuing expansion has given rise to the following opportunities within its research centre at High Wycombe.

Biological Safety and Patents Officer

Reporting to the Director of Microbiology and Process Research, this person will assist in the preparation and assessment of patents and in complying with UK and US legislation concerning the large scale culture of genetically engineered organisms.

Ideally, candidates should be microbiologists with post-graduate experience in molecular genetics and a working knowledge of recombinant DNA technology, but applicants with different relevant backgrounds will be considered. For this post it is important to be attentive to detail and to be able to write coherently. (Ref. RSS/PRI).

Fermentation Process Research

Research Investigator

We require a person to work on the production of compounds from genetically modified micro-organisms. This involves research and development of processes up to pilot plant scale, liaising closely with the microbial genetics and production groups.

The Company offers excellent salaries and benefits include 4 weeks holiday per year, contributory pension fund, private medical scheme, subsidised cafeteria and sports and social club.

Applicants, male or female, are invited to send a detailed CV or telephone for an application form to Miss D. Wardman, Assistant Personnel Officer, Searle Research & Development, Lane End Road, High Wycombe, Bucks. (Tel High Wycombe 21124 ext. 3374).

Candidates should be recent PhDs with a broad background in Microbiology/Biochemistry/Fermentation Technology. (Ref. R56/AM9).

Research Assistant/Technician

Another vacancy exists within this group for either a graduate or a person with an HNC (Biological Sciences). Candidates should have experience in the use of fermentors. (Ref. R56/AM10).

Microbial Genetics

Research Investigators

Two experienced PhDs are required to join a team engaged on the construction of bacterial strains particularly suited for the large scale production of cloned gene products.

One person is required to investigate protein turnover in *Escherichia coli* and ideally should have a strong background in conventional bacterial genetics. (Ref. R51/AM11).

The second person will be required to develop improved vectors for use with *Bacillus subtilis* and ideally should have cloning experience with that organism. (Ref. R51/AM12).

SEARLE

PARK HOSPITAL FOR CHILDREN

Headington, Oxford
LOCUM EEG TECHNICIAN (BASIC OR SENIOR GRADE)

We have a six to nine months vacancy for a Technician at this Hospital which is the National Centre for Children with Epilepsy. The Department provides a comprehensive clinical service to all paediatric hospitals in the Oxford Region. This involves work with Children and Adults who have neurological or behavioural disorders in close conjunction with a multidisciplinary team and includes sleep recordings, ambulatory monitoring and split screen video/telemetry techniques. Single channel recording may be available.

For informal visit and further details contact Mrs M. Morris, EEG Department, Park Hospital, Telephone Oxford 63461.

SALFORD AREA HEALTH AUTHORITY (Teaching)

THE SKIN HOSPITAL

UNIVERSITY OF MANCHESTER SCHOOL OF MEDICINE

SKIN RESEARCH UNIT

TECHNICIAN

This Unit is a joint venture between Colgate-Palmolive Ltd and the Manchester Skin Hospital and the University of Manchester School of Medicine. There is a programme for the study of the effects of various preparations on the structure and function of the skin. The post will include the organisation of clinical trials and various analytical methods for studying the skin surface. The successful candidate would be expected to have at least one 'A' level or equivalent in a Physical Science and preferably one or two years' experience in a laboratory.

Application—please apply with full curriculum vitae to: The Administrator, The Skin Hospital, Quay Street, Manchester M3 3HL.

UNIVERSITY OF LIVERPOOL

RESEARCH ASSISTANT IN ACOUSTICS

Applications are invited for the post of Research Assistant in the Acoustics research unit of the Department of Biological Sciences, tenable for up to three years from 1 January, 1982. The project concerns a theoretical investigation of vibration patterns in plates, specifically rectangular plates. Applicants should possess a good honours degree in mathematics, the physical sciences or engineering and knowledge of acoustics is desirable. Initial salary within the range £5285-£6070 per annum.

A copy of the application form, the names of three referees, should be received not later than 27 November, 1981, by the Registrar, The University, PO Box 147, Liverpool L69 3BX. Quote Ref: RV/883/NS.

STATISTICIAN & BIOMETRICIAN

We are the British subsidiary of one of the world's largest multi-national pharmaceutical companies. Our administrative offices and research and development laboratories are situated in pleasant surroundings at Taplow in Berkshire with easy access to London and the West Country.

Particularly in these times of bleak economic prospects, the Company has an enviable record of sustained growth and development and the two posts described below represent part of the continuing commitment to achieve success in new drug discovery and development. We wish to recruit two qualified statisticians for the following posts:

1. Biometrician - Research and Development Division (Ref: PHD/4)

The person appointed will act as internal consultant on the design of experiments and the evaluation of results. In addition the successful candidate will be the R&D Division's principal adviser on the use of computer systems.

2. Statistician - Medical Division (Ref: MD/3)

The successful applicant will join a small team responsible for the crucial area of design and analysis of clinical trials. The work also involves the development of systems for the collection, statistical analysis and interrogation of clinical data.

For both posts we are looking for a person with a formal qualification (at least to degree level) in statistics and a strong background and interest in the use of computer systems. Salaries offered will be within the band £7000-£10 000 and will reflect qualifications and experience. Benefits include 21 days annual holiday, a first class subsidised staff restaurant and an active sports and social club.

For further details and an application form please contact:
The Personnel Department, Wyeth Laboratories, Huntercombe Lane South, Taplow, Nr Maidenhead, Berks. Tel: Slough 28311 Ext 265



BRISTOL POLYTECHNIC DEPARTMENT OF SCIENCE

TEMPORARY LECTURER (GRADE II) IN CLINICAL CHEMISTRY - Ref No. L42/84

This post is tenable for one year commencing as soon as possible and terminating on 31 August, 1982.

Candidates should preferably have FIMLS qualifications and be familiar with all aspects of work in a hospital Clinical Chemistry Laboratory.

SALARY SCALE £6462-£10 431 per annum.

For further details and an application form, to be returned by 10 November, 1981, please contact the Personnel Office, Bristol Polytechnic, Coldharbour Lane, Frenshay, Bristol.

Please quote Reference Number L42/84 in all communications.

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EUROPE - AFRICA



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In the first instance, please write or phone for an application form to Mrs Jeni Money at the above address, or alternatively telephone her on Egham 34422.

THE UNIVERSITY OF LEEDS DEPARTMENT OF BIOCHEMISTRY

Applications are invited for a post of

RESEARCH FELLOW

in the Department of Biochemistry, to work on the mechanism of action of ATP synthase in chloroplasts. This is part of a continuing study of the control of ATP production and its relation to cell division in plant cells. An appointment will be made for a fixed period of up to two years.

Applicants should have, or shortly expect to receive, a PhD degree in a related area. Interests in applications of microtechniques to biochemical studies would be an advantage.

Salary scale: the range £6070-£8515 on the scale for Research and Analytical Staff according to age. Rate of pay: £15.00.

Application forms and further particulars may be obtained from the Head, The University, Leeds LS2 9JT, quoting reference number 83/41. Closing date for applications 30 November, 1981.

GUY'S HOSPITAL SEI ANALYTICAL TECHNICIAN

required for Pharmaceutical Department, to work in a large well-equipped laboratory undertaking the quality control of a wide range of medicinal products.

Previous experience in quality control work is desirable, and applicants must either be certificated Quality Technicians or hold ONC in Chemistry.

Guy's Hospital is conveniently situated near London Bridge and has excellent staff facilities including subsidised restaurants, swimming pool, squash and tennis courts and a staff club.

Salary £4720-£5918 inclusive. Further information may be obtained from John O'Brien, Queen Charlotte Street, 01-707-7600 ext 233. Job description and application forms from Personnel Dept, St Thomas Street, SE1 9RT, ext 3471, quoting Ref: P/66. Closing date 9 November, 1981.

MRC

Medical Research Council
NATIONAL INSTITUTE FOR MEDICAL RESEARCH
LABORATORY OF PHYSICAL ULTRASTRUCTURE

A POSTDOCTORAL SCIENTIST with experience in electron microscopy is required to join a group working on cytoskeletal elements in synapses and other nervous tissue.

The appointment would be for three years in the first instance in the salary range £7290-£8570 plus £360 per annum London allowance.

Applications should be sent to the Director, National Institute for Medical Research, Mill Hill, London NW7 1AA, by 27 November, 1981 quoting reference BU/3R.

THE POLYTECHNIC— WOLVERHAMPTON PRINCIPAL FACULTY TECHNICIAN

Grade: S02. Salary £8991 to £9528.

Applications are invited for the post of Principal Faculty Technician in the Faculty of Science. The post-holder will be responsible for the general supervision of the laboratory services and 42 technicians.

Duties and application form from: Establishment Clerk, The Polytechnic, Wolverhampton WV1 1SB or Tel: Wolverhampton (0902) 710654 (ansaphone).

SCIENCE GRADUATES. REALISE YOUR FULL POTENTIAL AS AN INSTRUCTOR OFFICER IN THE ROYAL NAVY.

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of 5 years at a starting salary of up to £9,702 p.a., depending on qualifications and experience, and with a tax-free gratuity of £5,050 at the end. Or you could leave after 3 years with a gratuity of £3,030.

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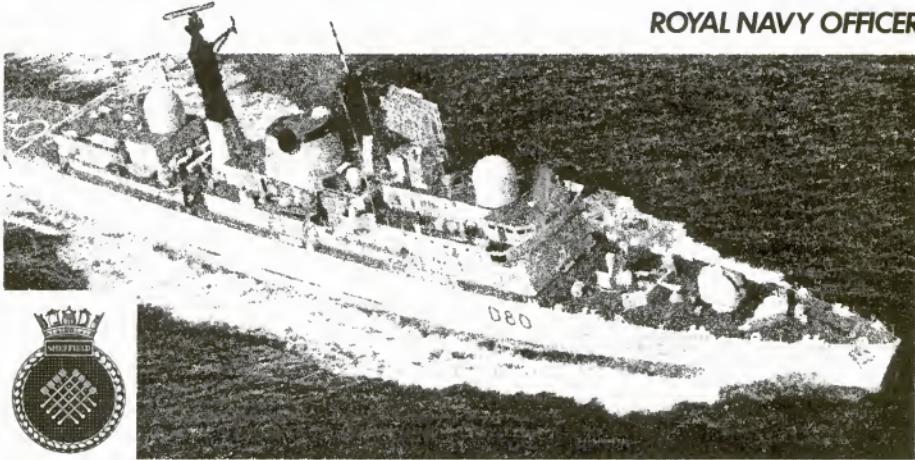
If you think you could meet the challenge of a career as an Instructor Officer and are between the ages of 21 and 33, write for further information and an application form to the address below.

A full c.v. is not required at this stage, but you should indicate briefly your main qualifications and subject.

Write to Lt Cdr A. B. Edouard BSc,
RN (609 SG 20), Room 120, Ripley
Block, Old Admiralty Building,
London SW1A 2BE.

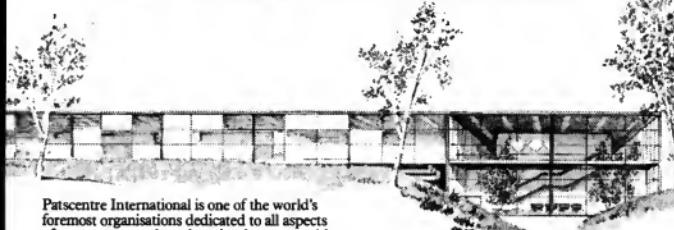


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Senior Materials Science Technician



Patscentre International is one of the world's foremost organisations dedicated to all aspects of new process and product development, with laboratories in the UK, Australia, Belgium and the USA, and covering almost every scientific and engineering field.

At our Cambridge Division we wish to recruit a technician to work as part of a team involved in materials science and chemistry. Candidates should have experience in:

- basic chemistry techniques
- routine laboratory management
- the preparation of a wide range of materials
- general fabrication of jigs, experimental rigs and prototypes



**Patscentre International
Cambridge Division**



1979

He/she will be expected to organise the day-to-day running of the laboratory, operate experiments using his/her own initiative, and make a positive contribution to the direction and achievement of the team.

Please write or telephone for an application form to Miss Jan Halson, Personnel Officer, Patscentre International, Melbourn, Royston, Herts. SG8 6DP. Tel: Royston (0763) 61222. Closing date: 12th November, 1981.

NATIONAL INSTITUTE FOR BIOLOGICAL STANDARDS AND CONTROL

Department of Blood Products

TECHNICIAN/ RESEARCH OFFICER

for work on the control and standardisation of components of the fibrinolytic system.

Applicants should have a degree or equivalent in biochemistry, chemistry or related field. Preference will be given to applicants with experience in techniques associated with the synthesis, analysis and characterisation of macromolecules. Familiarity with routine methodology associated with work in protein chemistry would also be helpful (electrophoresis, chromatography, peptide-mapping etc.).

Salary scale £4958-£6993/£7336 plus £259 London Weighting. Starting point would be dependent upon age and relevant experience. (Only applicants with a minimum of 2 years related experience can be appointed direct to Research Officer scale).

For further information and an application form, contact National Institute for Biological Standards and Control, Holly Hill, Hampstead, London NW3 6RB. Tel: 01-388 2222. Please quote reference no. BL/827. Closing Date 19 November, 1981.

ATOMIC ENERGY OF CANADA LIMITED RESEARCH COMPANY

COMPUTER ANALYST/ PROGRAMMER

The Mathematics and Computation Branch at the Chalk River Nuclear Laboratories requires an analyst/programmer to join a team providing mathematical and computing support to users of the Computing Centre.

The successful applicant will act as consultant on the use of numerical techniques to solve scientific and engineering problems, with special emphasis in the area of differential equations, and will develop and maintain associated computer software.

Candidates for the position should have a PhD or MSc degree in computer science or applied mathematics. Applicants should have a strong background in numerical analysis, and a knowledge of modern computational techniques for solving differential equations would be an asset.

The Computing Centre, which comprises a dual-mainframe Control Data Corporation CDC 6600/CYBER 170 Model 175 computer system, provides computing services to all subsidiaries of Atomic Energy of Canada Limited, via remote job entry terminals located in Ottawa, Toronto, Montreal, Pinawa, Manitoba and elsewhere.

The salary will be dependent on qualifications and experience. A good benefits package is provided.

Chalk River Nuclear Laboratories is located 190 kilometres northwest of Ottawa on the Ottawa River. Good educational facilities and year-round cultural and recreational activities are available in the Deep River/Pembroke area.

Qualified men and women are invited to send their curriculum vitae and university transcripts quoting file 10B-P45 to Employment Supervisor, Atomic Energy of Canada Limited, Research Company, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada, K0J 1J0. Closing Date 19 November, 1981.



Atomic Energy
of Canada Limited

L'Energie Atomique
du Canada, Limitée

UNIVERSITY OF NOTTINGHAM

School of Agriculture

Department of Physiology and Environmental Science
CROP PHYSIOLOGIST/MICROCLIMATOLOGIST

We have two vacancies in a team working on the response of ground-cover species to soil heating, with funding from the Overseas Development Administration. Successful candidates will have undertaken postgraduate postgraduate training in e.g. plant physiology, crop water relations or microclimatology. A knowledge of computing/modelling is essential for one of the posts.

Salary according to age and qualifications. In the Research Assistant IA or IB scales (lowest points £6070 and £6285 per annum plus £1000 per annum increments and applications (including names of two referees) to Professor J. L. Smith, University of Nottingham, School of Agriculture, Sutton Bonington, Loughborough, Leicester LE12 5RD.

mims

EDITORIAL ASSISTANT

Applications are invited from graduates in pharmacy, pharmacology or other life sciences for the position of editorial assistant for MIMS.

The applicant must have the ability to collect and assess scientific information and the confidence to liaise with members of the medical and pharmaceutical professions. No previous editorial experience is necessary.

Please write in full to Dr. C. Duncan, Editor, MIMS, 76 Dean Street, London W1A 1BU

UNIVERSITY OF MANCHESTER

Department of Obstetrics and Gynaecology
TECHNICIAN

is required, initially for one year, for a research post supported by London Research Project funds. The project involves the investigation of new contraceptive compounds acting locally in the female genital tract, and includes *in vitro* measurement of physical characteristics by time lapse photography and laser doppler spectroscopy. Candidates should have a degree in a biological subject or similar qualification.

Initial salary (grade 3) £4642 to £4853 per annum.

Application should be made before 13 November, 1981, to Mrs B. Steele, Department of Obstetrics and Gynaecology, Research and Teaching Block, University Hospital of South Manchester, Nell Lane, West Didsbury, Manchester M20 8LR.

RESEARCH TECHNICIAN

required for the MRC Human Biochemical Genetics Unit, University College London, Wolfson House, 4 Stephenson Way, London NW1 2PF. Good honours degree or equivalent essential. Previous laboratory experience an advantage. Appointment will be as research officer or technician scale (£6500-£7500 per annum plus £257 London Weighting). Apply by submitting full curriculum vitae with two named referees to Dr D. A. Hopkinson.

AREA DEPARTMENT OF MEDICAL PHYSICS & CLINICAL ENGINEERING LEICESTER ROYAL INFIRMARY

This department which is undergoing a planned expansion programme provides Medical Physics and Clinical Engineering services for hospitals of the Leicestershire Area Health Authority.

The department is based at Leicester Royal Infirmary and has close links with the Medical School on the same campus and also with the University Physics Department.

Applications are invited for a number of new posts which have recently been established in connection with the move to the new Phase III building which now houses the department.

1. BASIC/SENIOR PHYSICIST OR ELECTRONIC ENGINEER REF: SP/81

A new post has been established in the Instrumentation section of the department for a person to assist the head of section. Whilst a majority of the duties will involve developmental work, responsibility also exists for the servicing commitment which relates to most of the hospitals in the Area. Most aspects of electronics are required in the varied development projects which are undertaken; some of these involve research into new techniques, and are carried out in conjunction with medical staff. A team of five technicians are engaged in this work.

The servicing aspect of the section also comprises five technicians, who look after most of the patient orientated electro-medical instruments. Their concern is for the safety and performance of all such items, and repairs or modification are carried out accordingly.

There is a well equipped and well-staffed mechanical workshop which provides an excellent complement for both the servicing and development aspects.

The department has recently moved into new purpose built accommodation which offers very pleasant working conditions. It also facilitates close liaison with other sections of medical physics and clinical measurement. A significant proportion of work is carried out for or in conjunction with them.

Applicants should have a good hon's degree in Electronic/Electrical Engineering, or Physics, with reasonable experience of electronics development. Previous work in medical electronics would be an obvious advantage, and candidates should be conversant with the use of microprocessors and microcomputers.

Further information may be obtained from Mr G. C. Aucott, on Leicester 541414 ext: 237.

2. MEDICAL PHYSICS TECHNICIAN III/IV—RADIOSOLOTOPE SERVICE REF: TECH 1/81

Applications are invited for the above post; to join the radioisotope section of the department. The successful applicant will join a team of scientific/technical staff providing a comprehensive service to the area.

Duties would involve work in isotope imaging techniques using both rectilinear scanner and gamma camera, in vitro studies and *in vivo* studies. Of necessity, there will be close contact with patients in performing these duties.

Candidates should be qualified to ONC/HNC or equivalent. For entry into grade IV, experience in this type of work is desirable but not essential as in-post training will be provided. For entry into grade III, some knowledge of all aspects described and at least three years experience in one of those is essential.

Further information may be obtained from Mr D. J. Burridge, Leicester 541414 ext: 5124.

3. MEDICAL PHYSICS TECHNICIAN III/IV—ELECTRONICS DEVELOPMENT REF: 2/81

The successful applicant will be working in a well equipped laboratory and form part of a team engaged in the design, development and construction of prototype electro-medical equipment. He/she should be fully conversant with modern test equipment and have a practical knowledge of current electronic components and their applications.

The type of work undertaken by the electronics development section varies greatly, and ranges from small, constructional projects through to systems involving analogue, digital and microprocessor techniques.

The person appointed will be expected to participate in these projects at all levels and liaise with medical staff and professional colleagues as and when required.

Candidates should possess ONC/HNC electronics or equivalent, with 3 years relevant experience.

Further information may be obtained from Mr B. Codd, on Leicester 541414 ext: 5107.

4. MEDICAL PHYSICS TECHNICIAN III/IV—MEDICAL WORKSHOP REF: 3/81

The successful applicant will join an existing team of technicians in a small but well equipped workshop. Experience of all types of machining and fitting to toolroom standards is essential. Experience in working with plastics is an advantage.

Candidates should possess ONC/HNC engineering or equivalent for Grade III. Although candidates with at least four years relevant experience will be considered for appointment at Grade IV.

Further information may be obtained by telephoning Mr G. Fletcher on Leicester 541414 ext: 470.

5. MEDICAL PHYSICS TECHNICIAN III/IV—ELECTRO-MEDICAL SERVICE REF: TECH 4/81

The successful applicant will join the servicing section of the Medical Physics Department and will complete a team of five technicians responsible for the repair and maintenance of a wide range of electromedical equipment throughout the Leicestershire Area.

Candidates should possess ONC/HNC Electronics or equivalent. For Grade III, servicing experience is required although candidates with no such experience will be considered for appointment at Grade IV.

Further information may be obtained by telephoning Mr R. V. Foxon on Leicester 541414 ext: 5117.

6. MEDICAL PHYSICS TECHNICIAN III/IV—CLINICAL MEASUREMENT REF: TECH 5/81

The Clinical Measurement Section provides technician assistance on a wide range of clinical activities. However, the successful applicant for this post will be mainly concerned with the provision of technical support to the Sub-Regional Neo-Natal Unit. Duties will include routine checking and calibration of electromedical equipment.

Candidates should possess ONC/HNC (or equivalent) in a relevant subject. For appointment at Grade III, 3 years relevant experience is required. For appointment at Grade IV, experience whilst desirable is not essential, as in-post training will be given.

Further information may be obtained by telephoning Mr S. Bentley, on Leicester 541414 ext: 5486.

Salary scale for posts 2-6: Technician Grade IV £4668-£6137

Technician Grade III £5336-£7155

New entrants to the NHS will normally commence at the minimum scale point.

For any other information concerning any of these posts, please telephone Mr T. Griffiths, Chief Physicist on Leicester 541414 ext: 5134. Applications, stating age, qualifications and previous experience, together with the names of 2 referees should be sent to: The Personnel Department, Leicester Royal Infirmary, Leicester LE1 SVWV.

Closing date for applications—9 November, 1981.



**Leicestershire
Health Service**

LEICESTERSHIRE AREA HEALTH AUTHORITY(TEACHING)

Development Scientist

A challenging, early career move with an international leader in primary battery technology

Duracell is an expanding international company and a world leader in the manufacture of premium batteries. Significant increases in consumer demand for high quality power products have created an immediate need for a Development Scientist, male or female, within our European Research and Development Group at Crawley.

Reporting to the Development Manager, Materials and Processes, you'll be part of a small team of development specialists engaged in the preliminary laboratory evaluation of a wide range of materials used in batteries.

Ideally in your early 20s, with a degree in chemistry, you should have at least 2 years' research and development experience. A background in metals and/or inorganic materials would be an advantage.

Starting salary will be around £7,000 pa and we're offering a comprehensive range of large company benefits. Furthermore, as a highly successful international organisation we are able to offer significant career prospects in a number of directions.

For further details and an application form, please contact Richard Daulton, HQ Personnel Manager, on Crawley (0293) 26041. Or write to him with full career details at: Duracell Europe, Mallory House, Gatwick Road, Crawley, West Sussex.

DURACELL®



CRAVENFIELD Department of Materials RESEARCH FOR THE STEEL AND GAS INDUSTRY

Quality Assurance of Welded Structures

A numerate metallurgical or mechanical engineer with a good honours degree in one of the heavy fabrication and related industries, is required primarily for an SERC funded project on the quality assurance of offshore structures and related facilities. The ability and desire to work closely with the relevant industry is essential.

Arc Phenomena

A physicist with the ability to solve engineering problems is required to work on an investigation of welding arcs at high pressure. This is part of our SERC and industry funded programme on understanding the physical behaviour of arc phenomena.

It is expected that the quality assurance post will be in the salary range £5285-£7200 per annum, depending on experience, in the range £4715-£5091, but for the latter post an appointment on a higher scale may be possible. In the first instance the post will be initially for a 2 year term and it will be possible to register for higher degrees.

For application form and further information please contact:

The Personnel Section (ref. A9.39), Cravenfield, Department of Materials Research, Bofford, Bedford MK41 8AL. Tel: Bedford (0234) 730111, ext. 477.



Information Scientist

£7000-£8000

Berkhamsted

The Wellcome Foundation which is a major British based pharmaceutical company with progressive personnel policies has an exciting opportunity for an Information Scientist.

Based at our veterinary headquarters in rural Hertfordshire the job will involve the provision of a comprehensive service to R&D departments and management groups. Specific duties will involve scanning, indexing, reporting, editing, correspondence processing and support functions for R&D projects including the use of in-house computerised databases (IBM—STAIRS) for the input and retrieval of documentation.

Candidates should be graduates in one of the Biological Sciences, preferably Zoology, with a further qualification or experience in Information Science and will be given an opportunity to fulfil their potential in a challenging environment by taking an active part in developments within information and user departments.

Please write or telephone for an application form, quoting ref. NAA16 to: Mr J. Lurie, Site Personnel Officer, The Wellcome Foundation Limited, Berkhamsted, Herts HP4 2DY. Tel: Berkhamsted (04427) 3333.



Wellcome

ROTHAMSTED EXPERIMENTAL STATION HARPENDEN, HERTS AL5 2JQ

SOIL MICROBIOLOGIST OR BOTANIST

with an interest in plant/microbial interactions, particularly in the Soil Microbiology Department on biological nitrogen fixation. The appointment is for two years and funds will be available for the first year. Successful applicants will be required to develop ISEN based methods to estimate N-fixation by bacteria associated with the roots of tropical grasses and cereals. Some of the experiments will be done at ICRISAT in India and the appointee will be expected to spend part of his time there.

Qualifications: Good class honours degree and preferably a higher degree or equivalent and minimum of two years post-graduate research experience in an appropriate discipline.

Appointment in grade: Higher Scientific Grade (E6/SCA-E8/SCB).

Non-contributory superannuation.

Apply in writing to the Secretary, naming two referees and quoting Ref. 461 by 19 December, 1981. Further details on request.

SCIENTIFIC PROGRAMMER

Link Systems is one of the world's leading companies in the field of X-ray microanalysis and manufactures all components of a series of microanalytical computers called Vixen. We are looking for an individual with a good grounding in physics and mathematics to join our microanalysis group and develop programs for new applications. Computer skills should have a high degree or equivalent experience and knowledge of Fortran and assembly language programming would be an advantage. Salary negotiable.

Applications with C.V. and names of referees to: Dr P. J. Statham, Link Systems Ltd., Halifax Road, High Wycombe, Bucks. HP12 3SE.



UNIVERSITY OF WARWICK RESEARCH ASSISTANT IN THE PHYSICS OF MATERIALS

Applications are invited from research students experienced in Materials Science, Physics or a related subject for a research assistantship on the microstructure and mechanical properties of vitreous bonded ceramic grinding materials. The project is supported by a SERC grant awarded to Dr H. Lewis. Applications should demonstrate experience in using electron-optical techniques for microstructural analysis. The project which has excellent technical support, for three years starting as soon as possible. Salary on the Research Range 1A scale: £6000-£6500 per annum. Applications (no forms) should include a curriculum vitae and the names of two referees to the Academic Registrar, University of Warwick, Coventry CV4 7AL, application Ref. No: 11/2A/81/F. Closing date: 13 November, 1981.

Paisons Unit, New Cross Hospital,
Avenue Rd, London SE14 5ER

A vacancy exists for a

JUNIOR MEDICAL SCIENTIFIC OFFICER

is available for a post holding a 'B' level ref. in Chemistry and at least one other science subject.

Salaries £3584 and £3909 depending on age and qualifications.

For further details please write to Mrs Anne Moore, the Unit Administrator, at the address above.

Analyst/Programmers for Scientific Applications

The Computer Science Department at Greenford runs PRIME 400 and PRIME 750 computers, providing on-line facilities to a large number of users at various sites within the Company.

We wish to recruit three Analyst/Programmers, to work on a variety of projects concerned with the discovery and development of new drugs. Information systems, and data collection on microcomputers linked to the PRIME machines, are major current areas of application.

Applicants should have a scientific or mathematical background, preferably with a qualification to degree level, and at least one year's experience of FORTRAN programming in a scientific environment. For two of the posts, a knowledge of Z80 programming and the CP/M operating system would also be an advantage.

Starting salaries will be related to experience, probably in the region £10,000 to £11,000 including London Allowance and profit sharing bonus. Other major benefits include a non-contributory pension scheme, relocation expenses if appropriate and flexible working hours.

Please send a C.V. or telephone for an application form to: The Personnel Manager, Glaxo Group Research Limited, Greenford Road, Greenford UB6 0HE. Tel: 01-4423434, ext. 2707, please quote reference number 393.

Glaxo Group Research Ltd

Research & Development Chemist

BW Mud Limited, a well known company in the Drilling Fluids industry and part of the K.C.A. Group of companies seeks a Research and Development Chemist, due to reorganisation in their Aberdeen operation.

Responsible to the Technical Services Manager, the successful applicant will be at least an Honours Graduate in Chemistry/Applied Chemistry, will be able to show a history of success in a commercial and/or industrial environment, preferably relevant to the drilling fluids industry. The person we seek will be able to produce results in loosely defined situations. This important position will require involvement in the improvement of existing products as well as research leading to innovation. We offer an attractive salary commensurate with qualifications and experience along with the benefits you would associate with a progressive company.

Applications in writing should be sent to:

John McDonald,
K.C.A. Drilling Ltd,
Greenwell Road,
East Tullos,
Aberdeen.



Commonwealth Smelting Ltd, a wholly owned subsidiary of Australian Mining & Smelting (Europe) and part of the RTZ group is engaged in zinc and lead smelting at Avonmouth near Bristol

We have a vacancy in our Works Laboratories for a

SENIOR CHEMIST

to undertake method and instrumental development, and to become familiar with all aspects of the laboratory organisation so as to be able to deputise for any of the Group Leaders when required.

The department provides information to the smelter for process control and metallurgical accounting purposes. In addition, it supplies a service for hygiene and environmental monitoring, and for raw material evaluation and assistance in technical problem solving.

As well as classical chemical methods of analysis, instrumental techniques in use include AAS, AES and XRF.

It is desirable that applicants should have some familiarity with these latter techniques as well as at least 5 years experience in inorganic/metallurgical analysis generally. Applicants should hold an honours degree or equivalent in chemistry, preferably with postgraduate study of analytical chemistry.

Starting salary £8800 pa on a rising scale. Relocation expenses available.

CSL Commonwealth Smelting Limited **a member of the RTZ Group**

Please write or telephone for an application form to:
Mrs E. M. Newell, Staff and Training,
Commonwealth Smelting Limited, St Andrew's Road,
Avonmouth, Bristol BS11 9HP.
Tel: Avonmouth 823641

Cement Chemists for Construction Materials R&D

Redtech is a member of Redland Limited, a multi-national group principally concerned with the manufacture of building and construction materials.

We intend to expand the activities of our small group of technologists working on cement based building products. We wish to recruit two Physical Scientists preferably with some experience of the chemistry of hydraulic cements.

The successful applicants are expected to become very closely involved in experimental work and the interpretation of results, to plan research projects in detail and to be responsible for the execution of this work.

Although our own laboratories are well equipped, the successful applicants will be encouraged to seek out and make use of facilities in universities and elsewhere, as and when appropriate.

As well as the required experimental skills and technical background, an open-minded approach to this very conservative area of technology and enthusiasm are seen as the most important qualities for these jobs.

Starting salary £6,000 — £9,000 according to age and qualifications.

Relocation expenses are negotiable.

These posts carry the benefits you would expect to be found in a major industrial group, including 23 days annual holiday, contributory pension scheme, generous sick pay scheme, and good prospects for promotion both within the company and the group. Redtech is situated in the country on the outskirts of Horsham. There is a subsidised canteen on site and company transport to and from Horsham town.

Please telephone, reversing the charges, for an application form and further details, or write, quoting ref 16/51 to: R. A. G. Poulton, Personnel Manager, Redland Technology Limited, Graylands, Horsham, Sussex. Tel: Horsham 50222.

All applications will be dealt with in confidence.

Redland Technology

Technical Officer

May & Baker Ltd. is one of the Country's leading Pharmaceutical, Agrochemical and Fine Chemical manufacturers.

A Development Chemist is required in the Formulation Section at the Dagenham site. The job-holder will be involved in the development and formulation of products within the Agrochemical, Fine Chemical and Photographic areas. Duties will include the preparation of trial materials and recommendations for works processes.

The successful applicant will be at least qualified to HNC level, with a minimum of 18 months relevant experience, not necessarily in formulation. The position offers career progression with the possibility of further study and training.

The competitive salary is supplemented by a package of benefits which include a subsidised restaurant, sports facilities and a contributory pension scheme.

Applicants, male or female, should write or telephone for an application form to Mr. G. James, Employment Department,



M&B May & Baker

May & Baker Ltd., Dagenham, Essex.
Telephone: 01-592 3060 extension 3506.

THE HANNAH RESEARCH INSTITUTE
(for studies relating to the production and utilization of milk)

RESEARCH ASSISTANTS in the BIOCHEMISTRY DEPARTMENT

Applications are invited for the following two posts:

POST 1 The person appointed will be required to supervise the Institute's isotope counting facilities and will undertake routine measurements of milk used in studies within the Institute. In addition, the appointee will be required to collaborate in an agreed research programme, can concern lipid metabolism and the lactation of ruminant animals. Ref: HRI/45.

POST 2 The person appointed will be required to participate in a research investigation into the regulation of mammary tissue metabolism, with particular reference to intestinal and hepatic lipoprotein lipase. Ref: HRI/47.

Applicants should possess at least a Degree in Biochemistry, Biochemistry or a similar field.

Appointment will be at the grade of Scientific Officer—salary range £5176-£6896. A non-contributory pension scheme is available.

Further particulars may be obtained from: The Secretary, The Hannah Research Institute, ATR, BAR, Barley Lane, Buntingford, Herts, LU3 1PL, enclosing curriculum vitae and the names and addresses of two referees, should be forwarded by 20 November, 1981, quoting post references.

LIVERPOOL AREA HEALTH AUTHORITY (TEACHING)

Renal Dialysis Equipment
SENIOR CHIEF TECHNICIAN
(Medical Physics Technician Grade 1)

An experienced electronics/mechanics technician is required to supervise a team of senior technicians providing an equipment service for dialysis equipment in the Mersey Region. The work involves day-to-day management, setting of technical standards, instructing patients and staff in the use of dialysis equipment and user maintenance. It also includes administrative staff with the planning and development of services.

Applicants should have HNC or higher qualifications, plus 3 years appropriate experience or be currently serving in the MPT grade III or higher.

Salary £20500 rising by annual increments to £3537.

Requests for application forms and further information should be sent to the Employment Office, Ashton General Hospital, Smithdown Road, Liverpool L15 2HE. (Telephone number 051 733 4020, extension 91). Closing date: 18 November, 1981.

UNIVERSITY OF GLASGOW

Department of Chemistry
POSTDOCTORAL RESEARCH ASSISTANTSHIP

Applications are invited for the above. Self funded students are directed towards exploring new strategies in the design and synthesis of chiral and achiral inclusion compounds. The post, which is available immediately and is for one year, will appeal to synthetic organic chemists. The Department has excellent and wide-ranging research facilities and the post will be within Range 1A of the scales for Research Fellow and Analogous Staff (£6072-£8680) with placement depending on experience.

Curriculum vitae, list of publications, and the names of two referees should be sent as soon as possible to Dr. D. M. Nicol, Department of Chemistry, University of Glasgow, Glasgow G12 8QQ.

In reply please quote Ref No 4867N.

UNIVERSITY OF BRISTOL

Department of Physics

**RESEARCH
ASSISTANT**

Applications are invited for a post-doctoral position, tenable for one year and renewable for a second year, that is concerned with in-service interfacial lifetime prediction of glass fibre in epoxy matrix composite materials. The project will involve the use of a minicomputer to process photoelastic data obtained for single fibres that have been given different surface treatments.

Salary at the lower end of Range 1A — £6070-£6454 ps (£6860 at age 28). Applications, in writing, giving the names of two referees should be sent as soon as possible to Dr K. H. G. Ashbee, H. H. Wills Physics Laboratory, Tyndall Avenue, Bristol BS8 1TL.

**UNIVERSITY OF WARWICK
POSTDOCTORAL
ASSISTANTSHIP IN
SURFACE SCIENCE**

Applications are invited for a three-year SERC Postdoctoral Assistantship to work with Dr T. A. Delchar in the Department of Physics, on the development of surface spectroscopies using metastable helium atoms. In addition, the work will involve studies of the scattering of metastable helium atoms and fast neutral helium atoms from metal surfaces as a means of probing the potential contour of a metal surface. Applications should possess an undergraduate degree in either physics or surface chemistry. A knowledge of electronics and surface science techniques would be helpful, but not essential. Appointment is for three years, starting date by arrangement. Salary range 1A, starting £6070-£6575 per annum. Applications (no forms) should include a curriculum vitae and the names of two referees. Send to Assistant Registrar, University of Warwick, Coventry CV4 7AL, quoting Ref No: 11/A/81/F. Closing date for receipt of applications 18 November, 1981.

ROYAL FREE HOSPITAL**SCHOOL OF MEDICINE**University of London
Department of Neurological Science

Biology, biophysics or physics graduate required for

SENIOR TECHNICIAN

post to manage and operate fluorescence-activated cell sorter in a group studying the immunology of myasthenia gravis.

Applicants are sought with some general practical experience, either in cellular work, instrumentation, computing, relevant biophysics (eg optics, lasers), or electronics. The manufacturer's service engineer will provide the necessary training and back-up.

Post available for up to five years from 1 November, 1981, based at the Royal Free Hospital, Hampstead, London NW3. Salary on appropriate Whitley Council scale.

Application forms and further details available from the School Secretary, RFHSM, 17 Queen Square, London WC1N 1BP (01-537-5385 ext 54). Please quote Ref: JTT/St. Applications should be submitted as soon as possible.

Clinical Research Associate

Become an expert in Medical Communications

The frontiers of medicine are constantly being extended, thanks to improved channels of communication. Here at Lederle Laboratories, the pharmaceutical division of the international Cyanamid Organisation, there is ample evidence of our already significant contribution to the world of medicine.

As a result of internal promotion, we now have a vacancy within our Medical Department for a Clinical Research Associate based in the West Midlands area. Prime responsibility will be to communicate technical and clinical information about some of our key products to both individuals and large audiences of Specialists and Clinicians. Additional responsibility will include monitoring of clinical trials and commercial support for both our existing and new products.

Applicants, male or female, will be aged 24+ and have a Life Science degree, together with a minimum of 3 years' technical experience within the pharmaceutical industry or in a university/hospital environment. A higher degree in a relevant discipline, whilst not essential, would be an advantage.

Applications are sought from candidates throughout the UK who are prepared to base themselves in the West Midlands area. Relocation expenses together with attractive terms of employment and a company car, will be offered.

Write or telephone for an application form to:

Diana Hex, Personnel Officer,
Cyanamid of Great Britain Limited,
Fareham Road, Gosport, Hants PO13 0AS.
Telephone: Fareham (0329) 256131



Lederle Laboratories is a division of Cyanamid of G.B. Limited

UNIVERSITY OF LEICESTER
Department of Biochemistry
POST-DOCTORAL
ASSOCIATE

Applications are invited for an SERC-supported post-doctoral research associateship to work with Dr G. Turnock on the regulation of RNA synthesis during the synchronous mitotic cycle in *Phasmarum*. Experience of nucleic acid techniques would be an advantage. The appointment will be available from 1 October, 1981, and is tenable for two years at a salary within the range for Research Associates. Starting salary up to £7700 per annum. USS superannuation. Apply, quoting Ref LZA2, to Personnel Officer, Department of Biochemistry, University of Leicester, Leicester LE1 7RH. Former applicants need not apply.

UNIVERSITY OF READING
Department of Mathematics**RESEARCH OFFICER**

required as soon as possible for fixed-term period to work on the SERC-funded project "Numerical Methods for Eigenvalue Assignment with Applications in Control Systems". The post will be supervised by Dr C. N. K. Nichols at Reading and Dr L. R. Fletcher at the University of Salford. Some time will be spent at Salford. Applicants should have a recently submitted, a PhD in either numerical analysis (preferably linear algebra) or control theory with strong interests in control. Starting salary up to £7700 per annum. USS superannuation. Apply, quoting Ref LZA2, to Personnel Officer, University of Reading, Whiteknights, Reading RG6 2AH.

Technician or Senior Technician for, Sierra Leone

An experienced

Technician/Senior Technician

with HNC/Diploma or equivalent is required for 6 to 12 months (negotiable) to undertake all technical work and record keeping in a small newly appointed research laboratory in Sierra Leone. An important part of the work will be to train and supervise local technicians in field studies.

Holders must be familiar with laboratory techniques used in the diagnosis of common tropical diseases, notably malaria, schistosomiasis, onchocerciasis, Bancroftian filariasis and intestinal helminths, ie staining, skin snips and microscopy. The ideal candidate will be between 25 and 45 years of age, adaptable and conversant with conditions abroad. Salary on a scale £4958-£8583 with overseas allowances.

Please telephone Mrs Capie on 081-545 5422 Ext 412 or write to Medical Research Council, 20, Park Crescent, London WIN 4AL for an application form. Closing date 12 November, 1981.

UNIVERSITY OF BIRMINGHAM**Faculty of Medicine and Dentistry****Department of Physiology
RESEARCH ASSOCIATE/FELLOW**

Applications invited for this three year MRC funded post, to work on a project applying neuropharmacological techniques to a study of the visual cortex. Preference will be given to candidates with background experience in either visual neurophysiology or neuropsychology. Those who can demonstrate an adequate backing in neurophysiology will be considered.

Salary in the range £5285-£6880 according to qualifications, age and experience (with superannuation). Starting date negotiable.

For further details contact Dr A. M. Silito, Physiologist.

Applications (three copies) with curriculum vitae and the names of two referees to Assistant Registrar, Medical School, University of Birmingham B15 2TJ. Quote Ref: RA/Phys/681.

**PLANT BREEDING INSTITUTE
MARIS LANE, TRUMPTON, CAMBRIDGE CB2 3LG****POTATO BREEDER**

Applications are invited for the post of Potato Breeder in the Forage, Oil and Protein Department. The work will be concerned with the potato breeding programme, seed production, and breeding and selection and tolerance of potato cyst-nematodes.

Appointments will be at Higher Scientific Officer (salary £6530 to £6859 pa) or Senior Scientific Officer (salary £8209 to £10 322 pa).

Qualifications are a First or Upper Second Class honours degree in Agriculture, Botany or Agricultural Botany. Good together with (at HSC level) at least two years, and (at SSD level) at least four years relevant experience in potato breeding and selection, and experience of non-insectary breeding schemes.

Further particulars on request. Applications with curriculum vitae, and the names and addresses of three referees, should be sent to the Establishment Officer by 12 November, 1981.

Hoggett Bowers

Executive Selection Consultants

BIRMINGHAM. CARDIFF. GLASGOW. LEEDS. LONDON. MANCHESTER. NEWCASTLE and SHEFFIELD

Inorganic Chemist - Silicates Specialist

North East, Negotiable five figure salary

The client, a major subsidiary of a substantial worldwide corporation, has by effective marketing, professional management and substantial investment in product research and development, established an envied international reputation for their extensive range of technically advanced products. They now wish to strengthen their talented, highly innovative, research centre team, by the recruitment of an outstanding young Inorganic Chemist, able to apply specialist silicate chemistry knowledge to the evaluation and development of new product concepts, incorporating recent technology advances. Candidates should have a first degree in Chemistry with preferably PhD or post university experience in silicates chemistry. The excellent benefits package reflects the importance placed on this appointment and includes relocation assistance where applicable.

A.D. Kelly. Ref: 44108/NS. Male or female candidates should telephone in confidence for a Personal History Form 0632-327455, 4 Mosley Street, NEWCASTLE-UPON-TYNE, NE1 1DE.

UNIVERSITY COLLEGE LONDON

Department of Chemical and
Biochemical Engineering

RESEARCH ASSISTANT

Applications are invited for a Research Assistant to work on a Gas Diffusion Project at Merton Park. The project is funded by a three-year SRC grant of which a little over two years remain. The candidate should have a good honours degree in Chemical Engineering or a related subject, ideally with some research or industrial experience. Suitable candidates may register for a higher degree while holding this post.

Salary range £1B. from £5285 to £6000 plus £1000 increments. Application to Dr S. P. Waldram, Department of Chemical and Biochemical Engineering, University College London, Gower Street, London WC1E 7HE. From whom further details may be obtained.

THE UNIVERSITY OF SHEFFIELD

DEPARTMENT OF
MECHANICAL ENGINEERING

Applicants are invited from men and women for the post of

Senior Research Assistant

To work on a new test facility that will subject engineering materials to complex stress, strain and temperature conditions, impact loading and pressure (external and internal) load cycles. The post is funded by SERC and is tenable for a fixed term of 3 years, starting January 1982, £5100 per annum. The appointee will join an existing interdisciplinary research team working on many aspects of mechanical behaviour. Please write giving personal and career details to date to: Professor K. J. Miller, Department of Mechanical Engineering, University of Sheffield, Mappin Street, Sheffield S1 3JD. Quote ref: R42/H.

Research Scientists (PhDs)

Commencing salary £6,800-£7,100

ILFORD Limited, part of the research-based CIBA-GEIGY Group, is the main manufacturing company in the U.K. within the worldwide ILFORD Photographic Group. The company's products are black and white films and papers, the CIBACHROME range of colour products and equipment and photographic chemicals.

ILFORD is presently well advanced with a major restructuring programme which will bring all its manufacturing units within the U.K. under one roof at Maberley in Cheshire, by 1984.

Because of this programme and continuing investment in Research and Development we are now looking for further Research Scientists.

Ideal applicants will hold PhDs in Physical, Inorganic and Organic Chemistry. Industrial research or post-doctoral experience could be an advantage.

SYNTHETIC ORGANIC CHEMIST to work on a project concerned with the invention of components for chromogenic monochrome materials.

EMULSION CHEMISTS will work on projects concerned with improved techniques for crystal growth and sensitisation to light. Successful candidates will be based initially at Warley in Essex transferring to Maberley in early 1983. Assistance will be given in relocation to Essex and subsequently to Maberley.

Please write giving personal and career details to date to: Mr. I. W. Pierce, Manpower Development Manager, ILFORD Limited, Research & Engineering Centre, The Drive, Warley, Brentwood, Essex CM13 3AT.

ILFORD

UNIVERSITY OF NEWCASTLE UPON TYNE

Department of Geophysics and
Planetary Physics
POSTDOCTORAL RESEARCH
ASSOCIATE

Applications are invited for the temporary post of Postdoctoral Research Associate, to work with Dr W. O'Reilly on the NERC-funded project "The petrological history of magnetic minerals in igneous rocks and the development of methods for palaeomagnetism." This involves laboratory studies of the magnetic properties of natural and synthetic analogue of magnetic minerals, and field work, possibly a DSDP cruise. The post is available immediately after 1st November from the date of appointment.

Starting salary will be between £6670 and £6880 in the Range 1A salary scale: £6670-10,575 per annum, depending on age, qualifications and experience.

Applications, together with a curriculum vitae giving details of age, qualifications and experience and a list of publications, should be sent as soon as possible to Dr W. O'Reilly, School of Physics, University of Newcastle upon Tyne, NE1 7RU. Please quote reference NS.

THE DISTILLERS COMPANY LIMITED

ASSISTANT SCIENTIST

The Food Group of The Distillers Company Limited require an Assistant Scientist for work in the Spirit Yeast Fermentation Laboratory of their Yeast Research Department, Merton, Cheshire.

Applicants should have a HNC qualification in chemistry, preferably with two or three years laboratory experience in the use of yeast cultures and yeast fermentations and including the handling of gas liquid chromatography equipment. Applications from chemists with qualifications other than HNC will not be considered.

The person appointed would be directly responsible to the Microbial Biochemist in charge of the yeast production research projects as well as in routine laboratory work with eventual responsibility for day-to-day laboratory operations.

An application form can be obtained by writing to: The Yeast Research Manager, The Distillers Company Limited, Yeast Research Department, MERTON, Cheshire, CH2 8ES. Closing date for applications is 30 November 1981.

THE CITY UNIVERSITY

City Technology Limited
TECHNICAL ASSISTANT
R&D GAS SENSOR
TECHNOLOGY

The work will be multidisciplinary, involving development, testing and liaison with the production department on a new range of electro-chemical gas sensors. These devices are used to measure specific requirements in applications such as safety and combustion efficiency. We are looking for someone with some background of laboratory practice. Experience in building test rigs, servicing and maintaining electronic equipment would be useful.

Salary will be on a scale £4762 to £5473 per annum, plus £1016 per annum London Allowance, GLC Supplementary Allowance.

City Technology Limited is a company wholly owned by The City University. For application form, please contact Mr. R. B. Smith, City Technology Limited, The City University, 17/19 Sebastian Street, Northampton Square, London, EC1V 0HB. Tel: 01-253 3798. Closing date 15 November, 1981.

Senior Laboratory Technician — Microbiology

We are responsible for the UK manufacture of Glaxo pharmaceuticals and their sale in this country.

A Senior Laboratory Technician is required to assist in the running of a general microbiological section of a department. Duties would include investigation of contamination problems, raw materials, products and production processes, hygiene monitoring of production departments and taking new and existing formulation for adequate preservation.

Suitable applicants will be in possession of at least an HNC (Biology) or its equivalent and have had some years' experience in microbiological techniques with responsibility for junior laboratory assistants.

In addition to a competitive salary, the Company offers excellent conditions of employment including guaranteed bonus and non-contributory pension schemes and an active sports and social club.

For an application form please contact: Miss D. F. Weir, Personnel Officer, Glaxo Operations UK Limited, Priory Street, Ware, Herts. Tel: Ware 3232.

Glaxo Operations UK LIMITED

DEVELOPMENT SCIENTIST

Speywood Laboratories Limited is an entirely British company engaged in the research and development of new therapeutic and diagnostic products derived from human and animal plasma. Applications, for the position of Development Scientist in the above field, are invited from biochemists with at least two years post graduate research experience and a good knowledge of protein separation techniques.

The research laboratories are situated near Wrexham on the English/Welsh border.

Salary and benefits are attractive.

Letters of application, including curriculum vitae should be sent to:

Mrs S. M. Middleton
Speywood Laboratories Limited
Chancery House
East Street
Bingham
Nottingham NG13 8DR



SPEYWOOD LABORATORIES LTD
Chancery House, East Street, Bingham, Nottingham. NG13 8DR
Telephone (0949) 38665/6 Telex 377136

Marine Laboratory, Aberdeen
Department of Agriculture and Fisheries for
Scotland

Chemist/Chemical Oceanographer

... to join a team responsible for chemical aspects of the Laboratory's environmental study programme. This involves developing and improving analytical methods for trace elements in sea water, biota and sediments, and participating in survey work in coastal and estuarine waters and in experimental studies in artificial marine ecosystems. Some research vessel cruises involved.

Candidates, normally aged under 27, should have a good honours degree in chemistry or chemical oceanography. Post-graduate research experience in analytical chemistry and a knowledge of modern instrumentation would be desirable.

Appointment as Scientific Officer £5175-£6960 with starting salary according to qualifications and experience.

For further details and an application form (to be returned by 20 November, 1981) write to Scottish Office, Personnel Division, E-PM(PTS)3, Room 208, 16 Waterloo Place, Edinburgh EH1 3DN, telephone 031-556-8400 extension 5088 or 4311. Please quote ref: SA/27/DLC

Scientific Civil Service



Programmer? Interested in market research?

Henley-on-Thames, Oxon

Hallmark Cards, the world's largest producer of greeting cards has a vacancy for a Market Research Analyst at its European Division. This opportunity will be of interest to someone presently employed as a Fortran Programmer who would enjoy a broader range of work. The job-holder will be involved in the organisation and carrying out of fieldwork and in the analysis, interpretation and reporting of results. Candidates, male or female, aged 23-28, should hold a degree in a numerate discipline and have successfully

completed course work in statistics. They should have programmed in Fortran full-time for one year, be a good organiser and willing to travel.

We offer: * a competitive salary
* 4 weeks' annual holiday * non-contributory pension and life assurance plan * pleasant working conditions in the country yet near to London.

To apply, please send a detailed cv to: Mrs. Sarah Wood, Hallmark Cards Limited, Chiltern House, Station Road, Henley-on-Thames, Oxon RG9 1LQ.

MONASH UNIVERSITY
Department of Materials Engineering
CONTINUING LECTURER

Applications are invited for a continuing lectureship candidate for a position in Physics/Metallurgy. Experience in transmission electron microscopy and its application to the study of materials is preferred. The Department offers a four year course in Materials Engineering and has an established research school well equipped for research in the areas of polymers and ceramics. Liaison with industry is encouraged. Salary: \$A19 821-\$A24 037 per annum. Superannuation, Outstation Studies Programmes, travel and removal expenses, temporary housing assistance. Enquiries to Professor J. P. G. Clark. Applications including Ref No 25512, curriculum vitae and three referees to the Registrar, Monash University, Victoria 3800, Australia and a copy to the Association of Commonwealth Universities (Appointments), 36 Gordon Square, London WC1H 0PF by 14/12/81, from whom further particulars are obtainable.

UNIVERSITY OF GLASGOW
Department of Chemistry
POSTDOCTORAL RESEARCH ASSISTANTSHIP IN ORGANIC CHEMISTRY

Applications are invited for a Postdoctoral Research Assistantship, supported by the Ministry of Agriculture, Fisheries and Food, to explore a synthetic route to vomitoxin, an imidazole-12,13-dihydrotrichothecene mycotoxin, with the ultimate objective of preparing the α -labelled vomitoxin. Applicants should have an interest and experience in synthetic organic chemistry.

The appointment will be available from November 1982 for one year in the first instance at a salary of up to £2680 (Range 1A, Research and Analogous Staff scale) with USS benefits.

Applications, with curriculum vitae and the names of two referees should be sent as soon as possible to Dr R. C. Collier, Chemistry Department, University of Glasgow, Glasgow G12 8QQ. In reply please quote Ref No 48656.

IMPERIAL COLLEGE
Department of Metallurgy and Materials Science
SERC RESEARCH ASSISTANT

required as soon as possible for a nine-month period to study the mechanical properties of alumina in simulated space environments. Salary in the IA range (£7037-£9072 including London allowance), and USS membership.

Apply with curriculum vitae and names of two referees to Dr R. D. Rawlings, Dept of Metallurgy and Materials Science, Imperial College of Science and Technology, London SW7.

Metallurgists Opportunities in Nuclear Technology

The Atomic Weapons Research Establishment at Aldermaston, Berkshire, is a self-contained centre for scientific and engineering development of advanced nuclear technology for both defence and civil purposes.

There are currently two vacancies in the Metallurgy Division. The successful candidates will be concerned with weapon component R&D and metallurgical production operations involving radioactive or toxic metals. Initially, a large part of the work will be to provide assistance to the relevant building manager in the safe operation of the building and the processes therein.

Candidates must have an appropriate degree or equivalent or higher qualification, or have passed the Council of Engineering Institutions

part 2 examination in appropriate subjects, and have at least 2 years' relevant professional experience or training. In addition, experience with plant for hazardous material production or R&D together with an awareness of the safety considerations associated with radioactive and toxic materials is desirable.

Salaries: £6555-£8695, with starting salary according to qualification and experience. Promotion prospects.

For further details and an application form (to be returned by 19 November, 1981) write to Civil Service Commission, Alencon Link, Basingstoke, Hants, RG21 1JB, or telephone Basingstoke (0266) 68551 (answering service operates outside office hours). Please quote ref: T(T)85.

Ministry of Defence

THE GRASSLAND
RESEARCH INSTITUTE
HURLEY, MAIDENHEAD,
BERKS SL4 5LR

A Scientific Officer/ Higher Scientific Officer

is required in the Soils and Plant Nutrition Department to assist in research primarily on a project concerned with the chemistry of soil organic matter, particularly in relation to soil productivity and physical properties.

HIGHER QUALIFICATIONS:—Degree in Soil Science, Chemistry or Biochemistry. At least five years relevant post-qualifying experience for the higher grade.

SALARIES:—Scientific Officer £5176-£6964 per annum Higher Scientific Officer £6530-£8589 per annum

Pains of entry will be dependent on qualifications and experience. Applications, with curriculum vitae and the names of three referees to the Secretary by 13 November, 1981 quoting reference I/G/7.

NRCd, Hatfield Polytechnic

Head of Projects and Consultancy

The National Reprographic Centre for documentation is seeking a Head of Projects and Consultancy to be responsible for writing and updating a series of published state-of-the-art reports on modern methods of information dissemination (video discs, videotape copies, microfilm, etc.). The post also carries responsibility for NRCd consultancy.

The salary will be within the Burnham Lecturer/Senior Lecturer scale (£5427-£11 539) at a starting point dependent on qualifications and experience. NRCd is located at Bayfordbury near Hertford.

Further details and application forms from: The Staffing Officer, The Hatfield Polytechnic, PO Box 109, Hatfield, Herts AL10 9AB. Tel: 07072 68100.

Details of NRCd are on Prestel 2886.

NEUROPHYSIOLOGIST

Vacancy at Technical or Research Officer grade. Should have experience with single unit recording techniques in mammals as well as computer analysis of physiological data. Opportunity for active participation in ongoing physiological and behavioural primate research.

Apply: Professor J. Steele Russell, MRC Unit on Neural Mechanisms of Behaviour, 3 Malet Place, LONDON WC1E 7JG.



BEREC GROUP LTD

The Advanced Projects Group have a vacancy for a

Solid State Physicist

who will be required to develop new materials for photovoltaic applications with the emphasis being on silicon.

Candidates should be qualified to degree level or above and possess a knowledge of the electrical and optical properties of semiconductors. Some practical experience in the processing of semiconductors is desirable.

Duties will include the fabrication of thin film solar cells together with the measurement of their electrical and optical properties with a view to making continuous improvements in conversion efficiency. If you wish to be considered for the above vacancy please send full cv or phone for an application form to:

Finance and Administration Manager,
Berer Group Ltd,
18 Nuffield Way,
Abingdon, Oxon.
Tel (0235) 20502



THE UNIVERSITY OF LEEDS DEPARTMENT OF PHYSICS

Applications are invited for a post of RESEARCH ENGINEER

In Polymer Physics in the Department of Physics for the development of processes for high modulus polyethers. A good honours degree in Physics or Mechanical Engineering together with relevant postdoctoral experience in Polymer Science or Engineering is required. This post is available immediately for a fixed period of up to two years.

Salary at an appropriate point within the range £6880-£8925 on the IA scale for Research Engineers, plus Allowance Staff (£6070-£10 575), according to age qualifications and experience.

Informal enquiries may be made to Professor I. M. Ward, Department of Physics (telephone Leeds 51751 ext 7118).

Applications for further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT, quoting reference number 52/18/E. Closing date for applications 3 December, 1981.

MRC Medical Research Council Centre MECHANISMS IN TUMOUR IMMUNITY UNIT

RESEARCH ASSISTANT

Applicants are required for a vacancy which will occur shortly. The person appointed will be participating in immunological projects involving the complement system, lymphocyte toxicity, and immune response of tumours.

Applicants must have relevant Degree, HNC or equivalent qualification. Previous experience in tissue or cell culture is desirable.

For further details, contact Professor P. J. Lachmann (Cambridge 243237).

Applications in writing within the next two weeks, with CV and names of two referees, quoting reference number MT/6 to:

The Administrator, MRC Centre, University Medical School, Hills Road, Cambridge CB2 2GH.

Test Substance Controller

FORMULATION DEPARTMENT

Huntingdon Research Centre is the largest Contract Research organisation in Europe involved in the evaluation of pharmaceuticals, biologicals and agrochemicals.

The Formulation Department controls the receipt, storage and disposal of test substances and provides liquid and dietary formulations of these.

You will be checking, recording and authorising steps in our formulating procedures, so maintaining our high standards of product quality and test substance control.

Aged over 23 you should have 3 to 4 years' experience in a scientific environment and be educated to degree level (though consideration will be given to those possessing technical or nursing qualifications). We are looking for someone who can produce evidence of having successfully worked as a member of a team and who will be capable of producing meticulous records while working under pressure.

We offer an attractive salary and excellent benefits together with relocation assistance if required. The Centre is located in pleasant countryside with excellent road and rail links to Cambridge, London and the Midlands. The area is well known for its range of attractive, low cost housing.

For more details please write or telephone to the Personnel Officer, Laboratory Services Division, Huntingdon Research Centre, Huntingdon PE18 6ES. Telephone Huntingdon 890431, extension 3271.

Huntingdon Research Centre



AGRICULTURAL RESEARCH COUNCIL
INSTITUTE OF ANIMAL PHYSIOLOGY
BABRAHAM, CAMBRIDGE CB2 4AT

ASSISTANT SCIENTIFIC OFFICER

required for three year appointment in a cell tissue culture laboratory. Duties include medium preparation and sterilisation, responsibility for laboratory maintenance, some work with animal cell isolation, culture of tumour cells and maintenance of cell lines. Minimum educational qualifications: GCE 'O' in grades A-C or CSE (1) in four subjects including English and a scientific subject or maths. Salary in scale: £2006 at 17 to £3379 pa. Maximum starting salary at age 21 (or over) £4130 pa. The successful candidate will be encouraged to continue or undertake studies for ONC, HNC or TEC at the Technical College on a day-release basis. 4 weeks' paid leave and 10½ public holidays a year. Non-contributory superannuation scheme. Application forms may be obtained from the Secretary of the Institute quoting reference NRDC 4. Closing date 9 November 1981.

ROBERT GORDON'S
INSTITUTE OF
TECHNOLOGY,
ABERDEEN

SCHOOL OF
MECHANICAL AND
OFFSHORE
ENGINEERING

RESEARCH FELLOW

For major research project on drilling fluid flow (Science and Engineering Research Council—Marine Technology Directorate financed) in collaboration with offshore petroleum industry.

Salary in range £6070-£6880 according to qualifications and experience.

Details from:
**Secretary, Robert Gordon's
Institute of Technology,
Schoolhill, ABERDEEN
AB9 1FR.**

NATIONAL INSTITUTE FOR
BIOLOGICAL STANDARDS
AND CONTROL

Department of Viral Products

TECHNICIAN

to assist in the control of virus vaccines. Applicants should be qualified to HNC level, or its equivalent. Experience in virology would be an advantage.

Salary scale £4958-£6993 plus £859 London Weighting. Starting point would be dependent on age and experience.

Please write or telephone for an application form quoting ref. no. VP/098 to National Institute for Biological Standards and Control, Holly Hill, Hemel Hempstead, London NW3 6RB. Tel: 01 435 2222. Closing date 19 November, 1981.



BRL (UK) Ltd is a recently formed subsidiary of Bethesda Research Laboratories Inc. of Maryland, world leaders in the supply of research products for Molecular Biology, Immunology and Cell Biology. The new company, which is located in pleasant surroundings on the Science Park at Cambridge, has vacancies for the following:

TECHNICAL SERVICES MANAGER

The Technical Services Manager, who will report directly to the Managing Director, will be responsible for maintaining overall supervision of a quality control laboratory, and for providing technical liaison with customers. The successful candidate will have a PhD and post doctoral experience in a relevant discipline, and a proven ability to communicate freely with the scientific community.

TECHNICAL SALES REPRESENTATIVE

Sales representatives are required for all parts of the country. Candidates should have a degree or similar qualification in Biochemistry, Molecular Biology or Immunology.

For a one year posts the successful candidates will undertake an initial period of training in the United States. Attractive starting salary and bonus schemes are offered and a company car will be provided.

Applications should be addressed to Dr Frank Roberts, BRL (UK) Ltd, PO Box 145, Science Park, Milton Road, Cambridge CB4 4BE, (quoting Ref 1095), from whom further information can be obtained.

Royal Marsden Hospital,
Downs Road, Sutton, Surrey

Two Senior Grade Physicists

required in Clinical Physics Group involved in both routine work and research and development. One post is concerned with the application of x-ray CT-scanner to oncology, the other with the development of total body irradiation techniques. Practical knowledge of radiation physics essential, experience in imaging, radiotherapy planning and computing desirable. Excellent facilities available.

Salary scale £1834-£10 516 + £557 London Weighting. Application forms and further details from Personnel Office, Royal Marsden Hospital, Fulham Road, London SW3. Tel: 01 352 6171 Ext. 446.

Closing date: 12 November, 1981.

Scientist for Haematology and Blood Transfusion Work

This post based at the Army Blood Supply Depot, Aldershot, covers all aspects of blood group serology and transfusion. There are excellent facilities for further study and research on the long term preservation of blood. The successful candidate will assume responsibility for all internal quality control and organise the bi-monthly external assurance programme.

Candidates, normally aged under 27, should have a degree/HND/HNC/AIMLS, or equivalent, in an appropriate science subject.

Experience in haematology and blood transfusion, is essential.

Appointment will be as Scientific Officer (£5175-£6960), with starting salary according to qualifications and experience.

For further details and an application form (to be returned by 21 November, 1981) write to Ministry of Defence, CM(5)1b3, Room 310, Savoy Hill House, Savoy Hill, London WC2R 0BX. Please quote ref: SA/3/FYA.

Ministry of Defence

PLANT ECOLOGIST REQUIRED FOR CHINA

World Wildlife Fund invites applications for a post available in CHINA. AN ECOLOGIST to join its Giant Panda research and conservation team in the Wolong Reserve, Sichuan Province, China. The WWF/China Giant Panda project is being implemented over three years under the leadership of internationally-known wildlife biologist Dr George Schaller. Applications should be sent to Prof Hu Jinchu, WWF managing director. The field. Candidates should be PhD students or equivalent. A wide range of skills focus on the Giant Panda's ecology and feeding habits, with particular reference to bamboo. Applications, to include detailed CV, should be sent to:

Mark Hall

Conservation Liaison Officer
World Wildlife Fund
Avenue du Mont Blanc
116 Gland
Switzerland

UNIVERSITY OF LIVERPOOL

Department of Pharmacology and Therapeutics
POSTDOCTORAL SENIOR
RESEARCH ASSISTANTSHIP

Applications are invited for a Postdoctoral Senior Research Assistantship supported by Wyeth Laboratories, to work on oral contraceptive steroid pharmacology. Knowledge of high performance liquid chromatography techniques would be advantageous but not essential. Candidates should possess a higher degree in pharmaceutical biochemistry or related subjects.

The appointment is for two years commencing 1 December, 1981, at an annual salary of £6070 per annum with USS benefits.

Applications (two copies), together with the names of three referees, should be submitted not later than 20 November, 1981, by the Registrar, The University, PO Box 147, Liverpool L69 3BX. Quote ref: RV/886/N.

HOGGAR MTS ALGERIA BIOLOGIST/ GEOLOGIST

wanted for expedition July 1982. Details of interests, funds etc to Box D594.

MRC Radiobiology Unit

Harwell

PHYSICIST

Applications are invited for a SHORT-TERM NON-CLINICAL SCIENTIFIC post in this MRC Unit, tenable for three years, to work with Dr D. T. Goodhead. Candidates with post-doctoral or equivalent status will be preferred.

The successful applicant will undertake track structure calculations on simulated electron and heavy ion tracks. Their properties over nanometre distances will be related to existing and future experimental observations on the biological effectiveness of ultrasoft X-rays, α -particles and other ionizing radiations. He/she will join a multidisciplinary group of four scientists whose main emphasis is on fundamental mechanisms of action of radiation on mammalian cells at the cellular and molecular levels. An advanced Monte-Carlo simulation code for electrons is available and the computing facilities on site are excellent.

Salary and conditions of service according to the MRC non-clinical scientific scale. Hostel accommodation or housing may be available. Applications, with curriculum vitae and the names of two referees, should be sent to the Personnel Office, Medical Research Council, Radiobiology Unit, Harwell, Didcot, Oxford OX11 9RD, by 11 December, 1981.

Further particulars available on request.

THE UNIVERSITY OF LEEDS DEPARTMENT OF MICROBIOLOGY

RESEARCH FELLOW

Applications are invited for a post of RESEARCH FELLOW in the above Department in connection with a Medical Research Council project grant awarded to Professor D. H. Watson for work on isolating fragments of large DNA molecules using monoclonal antibody and biochemical methods, for use in fundamental studies on the virus antibody interaction and production of monoclonal and polyclonal reagents. The post is available from 1 February, 1982, or as soon as possible thereafter, to 31 October, 1983.

Applicants should have, or expect to have, a PhD. Applicants with a background of experience of protein separation, cell-free cleavage of DNA, physical techniques or with appropriate virological experience will be particularly welcome.

Salary will be the IA scale for Research and Analogous Staff (£6070-£10 575).

Informal enquiries about the post may be made to Professor D. H. Watson (Telephone 0522-441199).

Application forms and further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT, quoting reference number 96/15/E. Applications should be submitted as soon as possible.

CHEMIST/ BIOCHEMIST

required immediately to join the team of research and development team of an expanding medical diagnostics company, located in The North of England.

Applicants should possess a good honours degree, with experience in radioimmunoassay and related techniques e considerable advantage.

The post carries a high degree of responsibility and the ideal applicant will demonstrate drive and initiative and possess a mature outlook.

Salary is negotiable in the region of £8000 pa, plus a company profitrelated bonus.

Applications should be made in writing with full personnel details to: Box D562.

UNIVERSITY OF GLASGOW RESEARCH ASSISTANT

MSc or Microbiology graduate required for two years work in a joint research project between the Zoology Department, University of Glasgow, and the Microbiology Department, Western General Hospital. The project, funded by the Scottish Home and Health Department, is concerned with the study of mechanisms of the transmission and dissemination of salmonellas and other human pathogens. The successful candidate will be required to undertake a combination of laboratory and field-based investigations.

Salary will be within Range IB of the scales for Research and Analogous Staff set out in the Whitley Council Scale. Further particulars may be obtained from Dr P. Monaghan, Department of Zoology, University of Glasgow, Glasgow G12 8QQ, with whom applications (two copies) should be lodged.

In reply please quote Ref No: 4863.

QUEEN MARY COLLEGE University of London Chemistry Department POSTGRADUATE RESEARCH ASSISTANT

required for two years SERC supported appointments to prepare and grow single crystals, soft X-ray analysis, under the direction of Dr S. S. Urch. Initial salary in range £6250-£7000 p.a.

Please apply as soon as possible by letter enclosing curriculum vitae and names of two referees, to The Secretary, Queen Mary College, Mile End Road, London E1 4NS.

WANT TO LIVE IN THE U.S.A.?

American agency provides help.
For free information
write the UK address.

The Transatlantic Agency
(NS), 33 Great James Street,
London WC1. Enc. SAE.

UNIVERSITY OF CAMBRIDGE TECHNICIAN

to be responsible for Image Analysing Computer (QUANTIMET 720) together with certain optical microscopes to be used in metallographic materials research desirable. Salary range £5700 to £6850. Applications to Secretary, Department of Metallurgy, Pembroke Street, Cambridge CB3 9LT.

Toxicologist Quality Assurance

Smith Kline & French Research Ltd is the UK based research group of the international SmithKline Corporation. We are currently undertaking a phased expansion of our research activities and have recently moved to a new 39 acre site at The Frythe near the village of Welwyn.

An opportunity has now arisen in our Pre-registration Co-ordination and Information Department for an experienced toxicologist to assist the Head of Quality Assurance. The responsibilities involve ensuring that all studies concerned with the safety testing of new drugs are carried out in accordance with Good Laboratory Practice regulations. This will enable the person appointed to maintain considerable contact with the laboratory environment. The work will also involve assisting in the checking of reports of safety studies against raw data.

We are looking for a graduate in the biological sciences with 2-3 years practical experience in toxicology. A careful, meticulous approach to work, with an eye for detail and a pleasant but firm personality will be needed.

We offer competitive salaries on progressive incremental scales and a discretionary end-of-year bonus. Other benefits include free life assurance, an excellent contributory pension scheme, free membership of BUPA and flexible working hours.

Please telephone or write for an Application form quoting reference No. NSC/151 to Marie Alpar, Recruitment Administrator.

SMITH KLINE & FRENCH RESEARCH LIMITED
Research Institute, The Frythe, Welwyn, Herts.



CHEMIST

The Lights Laboratory of Wilkinson Sword Limited Technical Centre based at Acton has an interesting vacancy for a qualified chemist.

The successful candidate will work on projects in the development of match-based products, including product chemistry and packaging. Brymry and Swan Vesta Matches are part of our current range of products.

Ideally, applicants should be under 30 years of age and have the ability to work both within a laboratory team framework and on their own initiative. A chemistry degree is essential as well as an acceptable personality to mix happily with all ranges of company personnel within the UK and overseas.

We offer competitive salaries and all those benefits expected of a major organisation.

Interested men and women should write or telephone for an application form to:

The Personnel Manager,
Wilkinson Sword Limited
287 Acton Lane, London W4 5LE
Tel.: 01 994 3666



LONDON BOROUGH OF HARINGEY

Part-time Laboratory Assistant

required at St Thomas More RC School, Glendale Avenue, N22, to work 25 hours per week, £10.00 per annum. Senior Grade—Preparatory NJC Scale 1/2-£1174, others £1150-£1190 per annum inclusive which equals £1984 per annum rising to £3381 per annum including寒暑假.

The Science Department has 8 laboratories, 4 of which form a new suite on the school's new site. The person appointed would join a team of 3 other technicians.

Qualifications—3 GCSE 'O' Levels or 3 CSE Grade I passes in appropriate subjects.

Application forms available from: Chief Education Officer, Education Office, 48-52 Station Road, Wood Green, LONDON N22 4TY. Telephone No. 881 3000 ext. 31367. Forms returnable by 13 November, 1981.

The Indian Institute of Technology invites applications on plain paper before 3 January, 1982 for permanent faculty positions as Lecturer/Assistant Professor in the various disciplines. The total monthly emoluments will range from RS1500/- to RS2500/- at the present rate of allowances.

The Registrar
Indian Institute of
Technology
Madras-600 036, India.

VISITS

VISIT TO EUROPEAN SPACE AGENCY FACILITY, W. GERMANY
DFA (Defence Manufacturers Association) in conjunction with EUROSAY INCENTIVES LTD., invite scientists and other interested persons to visit the facility. Dates of visit are 2-5 Dec 1981 to ESA-ERNO-BREMEN, W. GERMANY.

Projects being discussed on:
1. Space Shuttle
2. Ariane Rocket Launch
3. Communication Satellites
4. Space Station
5. Marine Technology

DAY 1: 23 NOVEMBER, 1981
DEPART LONDON/HEATHROW
ARRIVE BREMEN, W. GERMANY
LATE AFTERNOON

ARRIVED BREMEN AND TRANSFER TO HOTEL

RECEPTION AND WORKING DINNER
INCLUDES BRIEFING OF VISIT ARRANGEMENTS
SINGLE ROOM ACCOMMODATION

DAY 2: 24 NOVEMBER, 1981
SPACELAB AND TRANSFER TO
PRESENTATIONS DURING MORNING
SESSION WITH SENIOR STAFF AT
SPACELAB

AFTERNOON: FULL TOUR OF
EUROSAY INC. QUESTION AND
ANSWER PERIOD
REFRESHMENTS FOR DELEGATES TO
DE-BRIEF WITH SPACELAB STAFF
DE-BRIEF WITH SPACELAB STAFF
DE-BRIEF WITH SPACELAB STAFF
FOR EARLY EVENING FLIGHT TO
HEATHROW.

REFRESHMENTS
DFA MEMBERS £235-00;
OTHER £200-00 (inc VAT).
Number of participants strictly limited.

In the first instance please forward application form with payment payable to EUROSAY INCENTIVES LTD.

EUROSAY INCENTIVES LTD.
(Goldmarks Green) 51-59 253214,
ILFORD HOUSE, 132/135 Oxford
Road, London, W1.

Name _____

Organization _____

Position _____

Address _____ Tel. No. _____

DFA Member £235 Yes/No _____

OTHER £200 Yes. (Please Indicate)

LECTURES, MEETINGS AND COURSES

FILM MAKING

Independent film company offers comprehensive course in 16 mm film production. Crosswind Films—Tel: 01-481 4579.

WANTED

CONSTANT DEVIATION

spectrometer, Hilger-Watts, good condition, wanted for client. Artec (I for E) Ltd, Salewheel House, Ribchester (tel: 215), Preston, Lancs PR3 3XU.

The Polytechnic of Central London

Microelectronics Short Courses

MES 2.1: Introduction to the Z80 Microprocessor Two-day beginner's course, 3-4 December 1981

MES 3.1: Microprocessor Programming Three-day course, 20-22 January 1982

MES 4.1: Introductory Microelectronics Principles Five-day beginner's course, 1-5 February 1982

This course will be repeated on 19-23 April 1982 and 19-23 July 1982

MES 4.1: Floating Point Arithmetic (Z80 Microprocessor)

Three-day advanced course, 25-27 February 1982

MES 5.1: Microprocessor Interfacing

Three-day course, 19-21 May 1982

PCL also offers a wide range of programming courses in most languages, and courses on other aspects of computing.

Further details and application forms from: Netta Swallow, Short Course Unit, PCL, 309 Regent Street, London W1R 8AL. Tel: 01-580 2020 ext 220 or 01-580 0099 (24-hour Answerphone)



Sports and Science?

Are you keen on sport, yet interested in Biology as well?

If you have 2 'A' levels, one of them in a science subject, Nonington College in Kent has got the perfect degree course to offer you.

B.A. (Hons) Movement Studies with Biology

Combine Sports and Science by studying for an Honours Degree that combines Movement Studies with Biology.

Human Biology, Animal Physiology, Ecology and Animal Movement are included in biological studies.

For an early interview ring Nonington College on 0304 840671.



Birkbeck College
(University of London)

Recent Advances in Inorganic Chemistry

10 Weekly Postgraduate Lectures commencing 11 Jan. 1982 at 6 pm. Lecturers include R. J. H. Clark, B. W. Fitzsimmons, C. D. Flint, M. B. Burhouse, L. F. Larkworthy, D. M. P. Mingos, P. J. Sadler, P. Thornton, P. L. Timms and D. S. Urch.

Course fee £40. Registered students of the University free. Registration forms from the Departmental Secretary, Chemistry Dept., Birkbeck College, Malet St. WC1E 7HX telephone 580-6622, ext. 223.

Following the Preliminary Announcement PLACES are now being reserved for:

Two Day Residential Conference 21-23 April, 1982

THE ROLE OF ANIMALS IN SCIENTIFIC RESEARCH AND THEIR EFFECTIVENESS AS SUBSTITUTE MODELS FOR MAN

OWENS PARK MANCHESTER UNIVERSITY

This Conference will provide a unique opportunity to spend two full days discussing the development of techniques which do not rely on animal experimentation.

The eminent speakers come from a wide range of disciplines, thus ensuring a full and detailed coverage of the subject.

Conference Fee has been set at the low figure of £50 for FULL TWO days accommodation and catering including the CONFERENCE DINNER.

Prof J. W. Bridges, U. of Surrey

Dr E. R. Carson, City U. of Lond.

Mrs Ruth Clayton, U. of Edinburgh

Dr T. Connors, MRC Carshalton

Prof D. S. Davies, Royal Postgrad. Med. S. Lond.

Dr Mary Dawson, U. of Strathclyde

Dr J. R. Fry, U. of Nottingham

Air Cdr J. E. Malcolm, Royal College of Surgeons

Prof C. D. Marsden, Inst. of Psychiatry Lond.

Dr I. H. Muir, Matilda & Terence Kennedy Inst.

Prof M. Panigel, U. de Paris

Prof Dennis V. Parke, U. of Surrey

Dr James Parry, U. Col. Swanscombe

Prof Paul Turner, St. Bartholomew's Lond.

Dr S. Vine, Late Chief Insp. Home Office

Mr R. N. T.-Wykeham-Fiennes, Late London Zoo

Chairperson to be led by Sir Francis Avery Jones

APPLICATION FORM AND PROGRAMME WITH FULL LIST OF TITLES MAY BE OBTAINED FROM:—

The Conference Organiser, THE HUMANE RESEARCH TRUST FOR MEDICAL & SCIENTIFIC RESEARCH, Brook House, 29, Bramhall Lane South, Bramhall, Stockport, Cheshire SK7 2DN. Telephone: 061 439 8041.

LASER WORKSHOP COURSES

Department of Physics, University of Essex

ONE-WEEK RESIDENTIAL COURSES ON LASER APPLICATIONS THIRD SERIES, SPRING 1982

Each course is designed to provide participants with an authoritative survey of the techniques, problems and possibilities in a broad area of laser applications, given by speakers from industrial, government and university laboratories.

LASERS IN THE PRINTING INDUSTRY (18-22 January 1982)

LASER PROCESSING OF SEMICONDUCTORS (1-5 February 1982)

OPTICAL METHODS IN ENGINEERING METROLOGY (15-19 February 1982)

LASER CUTTING, WELDING AND MATERIALS PROCESSING (1-5 March 1982)

PRINCIPLES OF OPTICAL COMMUNICATIONS (15-19 March 1982)

For details please write to the Liaison Officer, (NS), Laser Workshop Courses, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, or 'phone Colchester (0206) 862286 extension 2375.

**FIFTH ADVANCED SCHOOL
in
PROCESS
MICROBIOLOGY AND
BIOTECHNOLOGY**

UMIST
Manchester

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A R I A D N E

BUILDING cities in space is an exciting idea. It is being used at Colgate University, New York, as a basis for an introductory course in physics, not exclusively for physics students, but for those more interested in the liberal arts as well. Its instigator says that the pace of the course has been kept deliberately slow, "to avoid the mental inundation that students often suffer when they drink from the fire hose of introductory physics courses". I know what he means.

The course's *raison d'être* is really to educate the modern youngster, surrounded by technology, into some understanding of engineering, and pure and applied science and how to distinguish between them, for his better negotiation of the world and its pitfalls. Its strategy has clearly been carefully considered because it starts with a lecture on space colonies. Enthusiasm thus engendered, the fired-up student can survive the next two weeks of basic kinematics.

Each student is asked to carry out a project. They have produced such things as a space colony newspaper, several board games and the design of an elevator to travel from the centre of a rotating space city to its suburbs on the rim.

Students whose main interests are outside science reportedly do better than those aiming to graduate in the sciences. A feasible explanation is that it's more adventurous for the non-scientists.

A course on the opposite tack might do wonders, too. In any event, I am sure that Lord Snow would have been pleased. □

IN A play called *One Way Pendulum*, one of the characters occupies a lot of his time teaching "I speak your weight" machines to sing the *Hallelujah* chorus.

How technology copies art. It would be a simple matter to teach cash registers almost any piece of music, for the up-to-date ones signal amounts of money by different notes. The average supermarket now sounds like a school for teaching Morse code to radio operators or a piece of music by Stockhausen or John Cage. Perhaps it is art copying technology in this case. We are hardly likely to get records called *Down Memory Lane* with Stockhausen or John Cage's Greatest Hits. □

AΝ ARTICLE in *The Observer* described the atmosphere at the recent Commonwealth Conference as "non-confrontational". This opens up rich vistas. War could become "non-peace", illness "non-health" and so on. The language cannot stand still; it must develop and include new, or non-old words, to be non-unsafe.

On the other hand, another article in the same issue said that something "went down like a lead balloon". Though missing the point of the original phrase, it probably describes the potential popularity of the non-old construction. □

THE nuclear energy scene begins to resemble an Elizabethan play, with every character suspect, involved motives, changes of allegiance and knives appearing out of the dark.

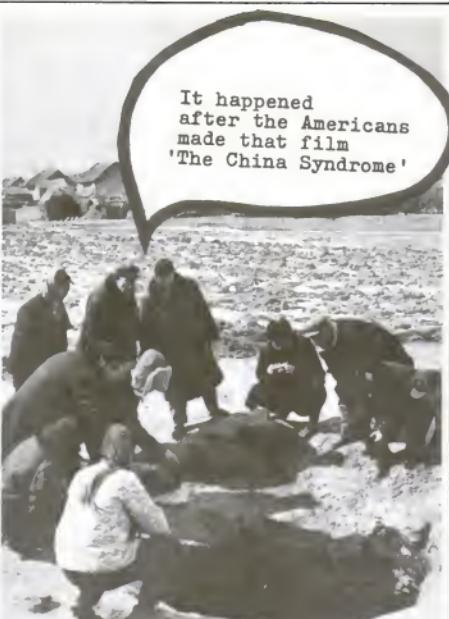
In the US the Long Island Lighting Company has slapped a \$2 million suit on an anti-nuclear group which tried to stop work on a nuclear power station. In Britain, the CEBG is thinking of financing opposition to its plans for building a pressurised water reactor at Sizewell. The idea is considered by many objectors, mainly Friends of the Earth, to be put forward metaphorically by a bunch of Greeks and they have backed off with cries of "Beware!" Meanwhile, back at the production end, the US is trying to get its hands on British plutonium, which the Foreign Office claims will not be used for weapons, a statement greeted in many places with the respect it deserves.

In a sub-plot, there has been a leak of iodine 131 from Windscale. Nothing to worry about, said the official spokesman, adding that the levels of iodine in milk had risen little, as a result. Whether he meant radioactive iodine or the normal kind will be resolved in Act IV. □

FLLOATING weeds like the notorious water hyacinth choke up and ruin many fine lakes and waterways throughout the world. A recent report (*New Scientist*, 10 September, p 661) suggests harvesting the weed mechanically and feeding it to cattle. A needlessly complicated procedure, thinks Daedalus: what you really need are floating cows.

DREADCO agriculturalists are accordingly developing a technology that enables cows to walk on water. Pilot experiments with simple buoyant jackets revealed some of the problems: to be stable a cow must float low in the water, but to browse easily on floating weed it must ride high.

The solution seems to be a system of fairly wide-set outrigger floats to stabilise the creature at a convenient height, and "frog-flipper" attachments to its feet to



enable it to propel itself. The apparatus will inflate automatically via water-sensors whenever the animal wades into the water, and will retract again to a simple form of harness when it comes out. When perfected, the equipment should enable cows to browse in meadows or weed-choked lakes indiscriminately. In fact it should make them perfectly amphibious.

Similar experiments are under way with sheep, pigs, and other grazing animals.

Not only will they effortlessly solve the problem of the water hyacinth, but they will convert vast areas of swamp and marshland to economic grazing land. The animal wastes, and maybe sewage, fed into such "hydropomic meadows" should be rapidly taken up by the plants.

The effects on the animals themselves remain to be seen. They may well take to the nautical life, and be reluctant to come ashore again. Aquatic sheepdogs may have to be trained, and amphibious tractors adapted for lassoing recalcitrant steers and towing them to land. Daedalus is also working on a mini-submarine-based underwater milking-machine to go from cow to floating cow, collecting the milk effortlessly. □

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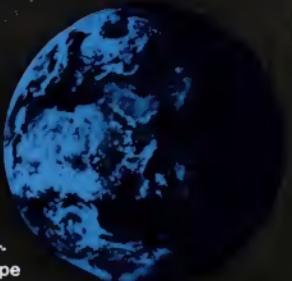
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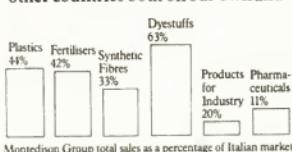
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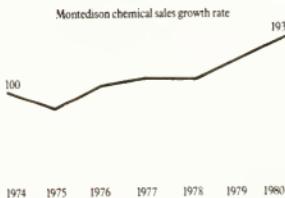
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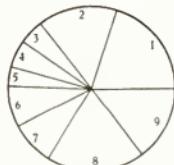
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